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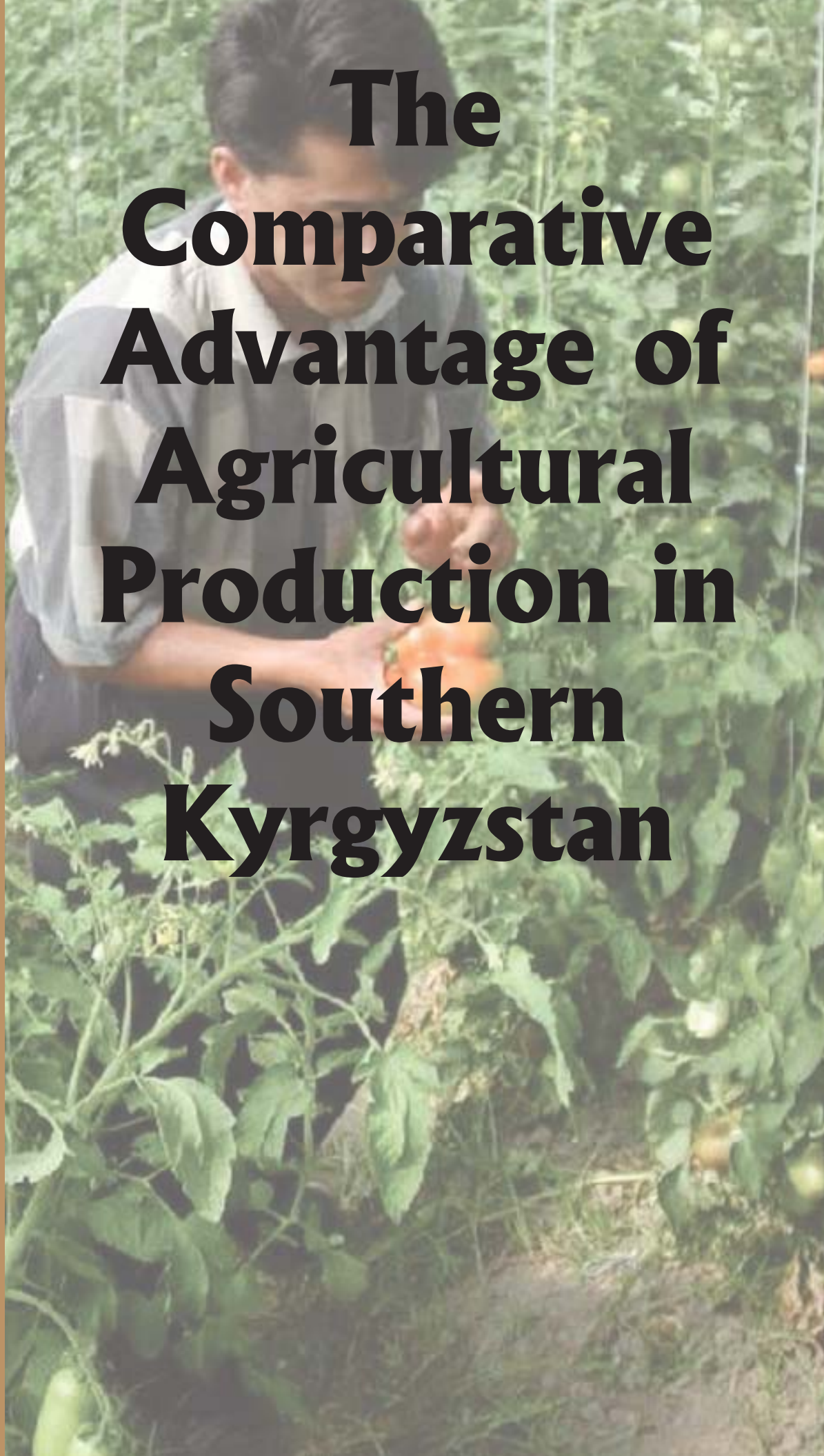

The Comparative Advantage of Agricultural Production in Southern Kyrgyzstan

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Foreword

This study was conducted as a component of the Kyrgyz Agro-Input Enterprise Development (KAED) Project implemented by IFDC in support of the United States Agency for International Development (USAID) Osh Agribusiness Initiative (OAI). The study was conducted in response to increasing concerns about the current comparative advantage and competitiveness of crop production and agribusiness enterprise development in Southern Kyrgyzstan. These concerns have emerged as a result of the rapid transformation that the economy and the agricultural sector of the country have experienced in the transition to a market driven economy. The information provided by this study on the comparative advantage of crop production in Southern Kyrgyzstan represents a significant contribution to the design of successful development assistance projects, public policy, and trade agreements involving Kyrgyzstan and countries in the Central Asia Region. The report of this study will be useful to the Government of the Kyrgyz Republic, national and international agencies, and development assistance organizations interested in promoting economic and agricultural development in the region.

Financial support from USAID and the Netherlands' Ministry for Development Cooperation to IFDC's development assistance efforts in Kyrgyzstan and the implementation of this study are gratefully acknowledged. Special thanks are given to Mr. Eamon Doran at USAID for his continuous support and encouragement in the development of this study.

A. H. Roy
President and CEO

Table of Contents

Acronyms and Abbreviations

c.i.f	cost, insurance, and freight
CPP	crop protection products
DRC	domestic resource cost
EPC	effective protection coefficient
f.o.b.	free on board
H-O	Heckscher and Ohlin
ha	hectare
IFDC	An International Center for Soil Fertility and Agricultural Development
km	kilometer
NPC	nominal protection coefficient
PAM	Policy Analysis Matrix
PCR	private cost ratio
VAT	value-added tax
WTO	World Trade Organization

The Comparative Advantage of Agricultural Production in Southern Kyrgyzstan

Executive Brief and Summary

Background and Objective

The Kyrgyz Republic is a mountainous landlocked country with a population of approximately 4.9 million people. Most of the population, more than 70%, live in rural areas. With a total land area of about 198,000 km^2, Kyrgyzstan is a small country where arable land accounts for about 7% of the total area. Agriculture is the most important sector of the economy; it accounts for 45% of GDP and 40% of the employment. Southern Kyrgyzstan includes the oblasts of Jalal-Abad, Osh, and Batken, which are part of the Ferghana Valley. This is a highly populated area where arable land resources are intensively utilized in agriculture. These oblasts have good climatic conditions for growing cotton, fruits and vegetables. However, the south is isolated from major export markets due to a poorly developed transport infrastructure and the lack of an effective agro-processing sector. High population density and the limited availability of arable land, about 0.4 hectare of arable land per capita, have caused increased poverty in rural areas and migration to the cities and to the northern region of Kyrgyzstan. However, it is evident that there is substantial potential for improvement in agricultural production and productivity and, therefore, agriculture is expected to remain the driving sector of the economy. The design of proper policies to promote the development and growth of agriculture is becoming an increasingly important priority for policymakers and the Government of Kyrgyzstan.

Worldwide innovations in agricultural production technology and the gradual transformation of agriculture in the transitional economies of neighboring countries have raised concerns about the competitiveness and economic feasibility of some agricultural crops in southern Kyrgyzstan. Kyrgyz farmers are being confronted with the challenge of price volatility and tough competition in most agricultural products. The majority of vegetables are imported from neighboring Uzbekistan throughout the year, wheat production is becoming less profitable, and seed producers have lost a significant market share in neighboring countries.

A small country such as Kyrgyzstan, with serious limitations in capital and technology and inefficiencies in agricultural production, confronts difficult challenges to succeed in a highly competitive international market. Newly independent small countries such as Kyrgyzstan have to overcome serious constraints and limitations in order to become effective participants in the world market. This goal is particularly more elusive and difficult to achieve if these countries try to compete with a wide range of commodities. Knowledge about comparative advantages can facilitate the identification and exploitation of the best opportunities for these countries to attain gains through improvements in exports and import substitution.

Reliable information about the economic efficiency, profitability, and competitiveness of agricultural production activities and enterprises and the factors and policies that constrain them is essential to design policies and development assistance projects that promote agricultural development and economic growth. Knowledge and information that is gained by conducting comparative economic advantage analysis for a country to produce and market agricultural products can be very useful for the design of policies to promote agricultural development and growth through the well-focused support of exports and import substitution. The main objective of this study is to provide such knowledge and information by assessing the compara-

tive economic advantage and competitiveness of the most important crop production enterprises in southern Kyrgyzstan using the Policy Analysis Matrix (PAM) methodology.

The PAM methodology is a very useful tool to assess the comparative economic advantages of production enterprises and economic activity at a given point in time and for a given set of circumstances. However, this methodology has limitations to evaluate the dynamic nature of competition. It is important to note that for the design of effective policies, other factors such as technical innovation, improvements in education, skills of the work force, and returns to economies of scale should also be considered in conjunction with information about comparative advantages. Changes in the economic environment, technology, and skills of the work force can significantly affect the competitiveness of a product, sometimes drastically.

To conduct this study, alternative sources of information were examined, and farmers and representatives of related sectors were surveyed to obtain better quality data. Aggregate data on agricultural land use and crop yields were obtained from the statistical records of Osh, Jalal-Abad, and Batken Oblasts. Quarterly prices for agricultural products and exchange rates for Osh (Kyrgyzstan), Andijan (Uzbekistan), and Almaty (Kazakhstan) for 1998-2002 were obtained from KAMIS Ltd. Crop yields and input use coefficients for various crops were obtained from farmers interviewed in the survey of farmers conducted in three southern oblasts, and the data primarily pertained to the 2002 production year.

Results

The main results on the comparative advantage of crop production in southern Kyrgyzstan are presented together with a summary of the implications of the results for the design of policies and development assistance programs.

Comparative Advantages of Crop Production—The following general conclusions on the comparative advantage and potential of crop production in southern Kyrgyzstan can be drawn from the results obtained in this study:

1. The resources of small- and average-scale farmers can be efficiently used for the production of vegetables to meet the demand of the domestic market and also potentially for the export market. These farmers have strong comparative advantages to produce tomatoes, onions, watermelons, cucumbers, and potatoes for the domestic market; and tomatoes, onions and watermelons for the export market. Estimates of indicators show that small- and average-scale farmers can obtain high profits and allocate resources in a manner that is efficient to the private and social interest. It is important to understand, however, that the estimated profits and, more importantly, the profits that farmers would realize from these crops will depend fundamentally on the stability of output prices. Prices can rapidly and substantially decline in response to the overproduction and excess supply of vegetable products that are perishable and difficult to store. Improvements in the marketing, storage, distribution, and processing of vegetable products are required to reduce the output price volatility that has characterized the market for vegetables in southern Kyrgyzstan in recent years. With respect to vegetable production for exports, the production and handling of export-quality vegetables involve the adoption of modern technology to produce, market, and process vegetables properly. Therefore, important technical and financial constraints must be overcome if the apparent comparative advantage of vegetable crop production is to be realized by small- and average-scale farmers in southern Kyrgyzstan.

2. It is important to note that if the benefits of increasing vegetable production to meet the demand of the domestic market and to boost exports are realized, the incomes of small-scale farmers and the rural labor force in southern Kyrgyzstan should increase significantly along with important gains in foreign ex-

change. Thus, increasing vegetable production on an economically sound and sustainable basis could have an important positive impact on poverty alleviation and the balance of trade of Kyrgyzstan.

3. Small-scale farmers also have good comparative advantages to produce (1) maize to substitute imports for the domestic market as a non-tradable commodity; and (2) sunflower to meet the domestic demand. These two crops have lower risk and less technical and financial constraints than do vegetable crops. Small- and average-scale farmers have only a moderate comparative advantage to produce wheat, but they are expected to continue to produce wheat for food security reasons and, if needed, to substitute imports. In addition to low prices of wheat in the world market, poor yields on about half of the agricultural land undermine the efficiency of wheat production. Also, because of the current structure of the flour mill industry, most of the profits of wheat production and processing are captured by the flour mills. Thus, a better distribution of profits between the farmers and the flour mills could significantly increase the profitability and comparative advantage of wheat production to the domestic market. The flour mill industry should be appropriately developed and competition enhanced.

4. Average-scale farmers have good comparative advantages to produce (1) rice, cotton, maize, and sunflowers for the domestic market and (2) cotton and maize for exports and import substitution, respectively. These farmers have only a moderate comparative advantage to produce wheat for domestic consumption and to substitute imports.

5. Large-scale farmers can use their resources more efficiently in the production of cotton for the export market, maize to substitute imports, and both crops in addition to sunflowers to satisfy the domestic demand. As is the case for average-scale farmers, these farmers also have only a moderate comparative advantage to produce wheat for domestic consumption and to substitute imports.

6. The profitability of barley production under current conditions is negative. Thus, unless market conditions change, the production of barley by average and large-scale farmers should be discouraged.

7. Greenhouse production of tomatoes and cucumbers is apparently very profitable capital-intensive enterprises, which can use resources efficiently to achieve high levels of private and social (economic) profits and low domestic resource cost ratios. Comparative advantages of these enterprises in southern Kyrgyzstan are very strong for the production of tomatoes and cucumbers for the domestic market and to substitute imports, especially during the winter season. Unfortunately, most of the caveats indicated above about the production of open-field vegetables also apply to these greenhouse production enterprises but with significantly greater requirements for capital investment (financial constraints), technical know-how (technical constraints), and entrepreneurial capacity. Investments in these enterprises should be carefully evaluated and compared with alternative investment opportunities, taking into consideration levels of risk and uncertainty. Results concerning the greenhouse production of watermelons are not encouraging.

Implications for Policy Design and Development Assistance—The evaluation of comparative advantages of crop production in southern Kyrgyzstan, which is conducted here using the PAM method, provides very useful information to identify policy issues that should be addressed and development assistance programs that should be considered to promote the development of the agricultural sector in Kyrgyzstan. The implications of the results (and information presented above and of additional analyses conducted as part of this evaluation) are used here to identify the following policy issues and the need for development assistance programs that should be addressed:

1. The VAT that is currently imposed on imports of agricultural inputs increases the prices and reduces the use of inputs such as fertilizers and pest control products that are essential to increase the productivity of

crop production in southern Kyrgyzstan. This tax was established mainly to generate revenues needed by the government to maintain a balanced budget, but given the adverse effects the tax has on agricultural development, serious consideration should be given to the removal of this tax on agricultural inputs. Alternative tax policies that are less detrimental to the economic development of Kyrgyzstan should be considered and evaluated as means of government revenue. In this study, the possible replacement of this tax with a tax on land is evaluated using the PAM method as a tool for analysis. It is estimated here that less than 5% of the agro-inputs supply in the country are legally imported and pay the VAT. Thus, it is apparent that this tax on agricultural inputs is not a very effective way to generate government revenue.

2. Large farms are expected to pay a 20% VAT on the sale of crop outputs in excess of annual revenue of 300,000 Soms per farm. Results of analysis conducted in this study on the consequences of this tax indicate that large-scale farms are greatly hampered by this tax. Indicators of profitability protection show that the 20% VAT is a very distorting policy that reduces private profits substantially and may have a significant adverse impact on the ability of large-scale farmers to compete in the production of crops such as cotton for the export market. This is a policy issue that needs to be revisited and addressed.

3. An in-depth assessment of the feasibility to invest in facilities and infrastructure for storage, marketing, and processing of vegetable products will greatly facilitate the decision-making on the implementation of these investments. Improvements in the storage, marketing, and processing of vegetable products are needed to realize the benefits of an increased production of vegetables by small- and average-scale farmers having evident comparative advantages in the production of these crops.

4. Financial constraints are often severe impediments to the establishment of modern crop production enterprises and to the adoption of improved technology. Access of farmers and agribusiness entrepreneurs to financial resources is critical to the success of efforts and programs to promote improvements in the productivity and competitiveness of crop production. Policies and programs to facilitate the availability of credit to farmers and agribusinesses should be considered as key components of efforts to enhance the success of increased crop production, in general, and of export crops, in particular. Financial resources are needed to facilitate the production and export of vegetables and main crops that can be efficiently produced in southern Kyrgyzstan with strong comparative advantages.

5. Constraints to the access and adoption of improved technology for crop production and agribusiness development usually are the other main obstacles to the establishment of crop production and agribusiness enterprises that can efficiently produce and supply agricultural products to the domestic and import markets. Programs to facilitate the development and transfer of improved technology to farmers and agribusiness entrepreneurs are needed in Kyrgyzstan to enhance the success of crop production and agribusiness enterprises in a highly competitive export market. The potential for yield increases of various crops in Kyrgyzstan requires further detailed analysis and should be studied separately. A project conducted by IFDC in southern Kyrgyzstan is assisting in the development of technology transfer centers that have been researching crop seed varieties and different management practices to identify technologies that can be adopted by farmers to increase crop yields and improve economic efficiency. Improvements in the technical and entrepreneurial expertise of farmers and agribusinesses and a skilled labor force can significantly enhance the success of development programs, in general, and the continuous competitiveness of crop production and agribusiness enterprises, in particular.

6. Although the PAM method is based on static analysis that fails to account for the dynamic consequences of changes over time, the method is useful to obtain valuable information about the comparative advan-

tages of crop production enterprises in a given country or region within a country at a given point in time. If assessments of comparative advantages for crop production similar to the one done here for southern Kyrgyzstan are conducted in neighboring countries (and potential trading partners), it will be possible to better identify trade patterns that will benefit two or more countries in the region. This information can then serve as a basis for the establishment of trade agreements that provide mutual benefits to the countries involved.

7. Trade agreements are very useful to promote trade that stimulates economic development and provides benefits to participating countries. Trade agreements facilitate the growth and stability of export-oriented enterprises and tend to reduce the risks and uncertainties associated with a highly competitive international market. In this regard, trade agreements are particularly important and beneficial to countries such as Kyrgyzstan, which have relatively small economies.

The Comparative Advantage of Agricultural Production in Southern Kyrgyzstan

I. Introduction

Background

Kyrgyzstan is one of five Central Asian newly independent states that are undergoing a metamorphosis of transitional policy reforms since gaining independence in 1992. Agricultural development in Kyrgyzstan and other republics of Central Asia is a frequently addressed issue and topic of discussion among policymakers and agencies interested in promoting economic development and growth. Agriculture is the most important sector of the economy in Kyrgyzstan and remains the dominant source of economic activity contributing 45% to the domestic product and about 40% to employment. Thus, development of the agricultural sector is a government priority. In the early and mid-1990s, agricultural exports, mainly to the Commonwealth of Independent States (CIS), consistently exceeded imports but exports of processed food products declined substantially from about $127 million in 1996 to only $11.8 million in 2000.

Reliable information about the economic efficiency, profitability, and competitiveness of agricultural production activities and enterprises and the factors and policies that constrain them is essential to design policies and development assistance projects that promote agricultural development and economic growth. This study is particularly important for Kyrgyzstan because it will contribute significantly to the provision of such information. The benefits of this study are further enhanced by the fact that Kyrgyzstan, as a newly independent state, is pursuing policy reforms toward the establishment of a free market system. Proper knowledge about the comparative advantage of agricultural production will expand the gains that a free market economy and international trade will offer to Kyrgyzstan's economic development and growth.

A small country such as Kyrgyzstan, with serious limitations in terms of capital and technology and inefficiencies in production and the use of factors of production, confronts difficult challenges to succeed in a highly competitive international market. The newly independent small countries have to overcome serious difficulties in order to become effective participants in the world market. It is particularly difficult for these countries to compete successfully with a wide range of commodities. Knowledge about comparative advantages can facilitate the identification and exploitation of opportunities to maximize gains through increased exports and import substitution.

Worldwide innovations in agricultural production technology and the gradual transformation of agriculture in transitional economies have raised concerns about the competitiveness and economic feasibility of some agricultural crops in southern Kyrgyzstan. Kyrgyz farmers are facing the challenge of price volatility and tough competition in most agricultural products. Most vegetables are being imported from neighboring Uzbekistan throughout the year, wheat production is becoming less profitable, and seed producers have lost a significant market share in the neighboring countries.

Objectives

Knowledge and information that is gained by conducting comparative economic advantage analysis of a country (or region within a country, as in this case) to produce and market agricultural products can be very useful for the design of policies to promote agricultural development and growth through the well-focused support of exports and import substitution efforts. Information obtained through comparative economic advantage analysis of agricultural production facilitates the more efficient allocation of resources in the production, processing, and marketing of agricultural products. The main objective of this study is to provide such knowledge and in-

formation by assessing the comparative economic advantage and competitiveness of the most important crop production enterprises in southern Kyrgyzstan using the Policy Analysis Matrix (PAM) methodology.

Although the PAM methodology is a very useful tool to assess the comparative economic advantage of production enterprises and economic activity at a given point in time and for a given set of circumstances, this methodology has limitations to evaluate the dynamic nature of competition. It is important to note that for the design of effective policies, other factors such as technical innovation, improvements in education and skills of the work force, and returns to economies of scale are also considered in conjunction with information about comparative advantages. Changes in the economic environment, technology, and skills of the work force can significantly affect the competitiveness of a product, sometimes drastically. Considering the various factors and interactions that one must reflect upon in the development and design of policies, the specific objectives of the study are as follows:

- Assess the comparative advantage of producing and marketing a selected number of important crops—grain and main food crops, vegetable crops, and greenhouse crops—in southern Kyrgyzstan.
- Identify agricultural products and crops with greater potential for import substitution and export promotion.
- Assess returns to (and economies of) scale of crop production under current constraints and market and policy environments.
- Identify policy distortions and market failures and assess their impacts on the allocation and the economic efficient use of resources, the profitability of crop production enterprises, and the economic welfare of the country.
- Identify policy options and strategies that may be adopted to promote economic gains through export and import substitution, increase employment and the incomes of farmers and the rural population in southern Kyrgyzstan, and improve the productivity of agricultural resources.

Agricultural Sector and Policy in Kyrgyzstan

The Kyrgyz Republic is a mountainous landlocked country with a population of about 4.9 million people. Most of the population, more than 70%, live in rural areas. With a total land area of about 198,000 km^2, Kyrgyzstan is a small country where arable land accounts for about 7% of total area. Southern Kyrgyzstan includes the oblasts of Jalal-Abad, Osh, and Batken, which are part of the Ferghana Valley, a highly populated area where arable land resources are intensively used in agriculture. These oblasts have good climatic conditions for growing cotton, fruits, and vegetables. However, the south is isolated from the main export markets due to a poorly developed transport infrastructure and the lack of a significant agricultural processing sector. There has been a lack of investments in domestic food processing industries, and obsolete processing facilities cannot meet the demands of the market. Also, high population density and the limited availability of arable land, about 0.4 ha of arable land per capita, have caused increased poverty in rural areas and migration to the cities and the northern region of Kyrgyzstan. The poverty level in rural areas is still very high and efforts to reduce poverty are stalled by serious problems in the agricultural sector. Agriculture is the most important sector of the economy and accounts for about 45% of the gross domestic product. Because there is apparently a substantial potential for improvement in agricultural production and productivity, agriculture is expected to remain the driving sector of the economy. Therefore, the design of proper policies to promote the development and growth of agriculture should be viewed as an increasingly important priority for policymakers and the government of Kyrgyzstan.

After 1991, agricultural production in Kyrgyzstan significantly decreased as a result of a sequence of adverse economic factors and circumstances. Some of these factors were the elimination of subsidies, industrial sector shutdowns, disruption in support services, and the worsening balance of agricultural trade. The introduction of a market-driven economy unfamiliar to the people of Kyrgyzstan engendered perceptions of uncertainty and risk that have con-

tributed to the contraction of the economy and the decline in agricultural production.

Relative factor prices have been changing over the years, caused in part by the depreciation of the capital assets that were provided by the old system, the shift of labor to agriculture, and the access to the world market. The changes in relative prices of factors and inputs in conjunction with changes associated with the introduction of a market-driven economy, such as market-determined output prices, are causing input substitutions and gradual changes in agricultural production technology. For example, decreases of wage rates and prices of agricultural outputs have substantially reduced economic incentives to use agricultural machinery and equipment, thus making the agricultural sector more labor-intensive and less mechanized than in the old system.

Agricultural sectors in transitional economies, more than other sectors, have experienced slower and more difficult paths of adjustment towards market equilibrium due in part to the nature of agricultural production and the large number of farmers and entrepreneurs. Many farmers in southern Kyrgyzstan have been involved in subsistence agriculture, and it takes several years for farmers to understand the market realities about output price volatility and uncertainty. This usually is a learning-by-doing process, which involves disappointing experiences by farmers experimenting with crop substitutions based on the expectation that current prices will prevail at the time the crops are harvested and the outputs sold. Overproduction and low prices and losses for one crop in a year have been often followed by high prices for that crop in the following year. Moreover, events affecting the world market, such as wheat production performance in Russia and Kazakhstan, the price of cotton in the international market, and agricultural subsidies in Uzbekistan, are always influencing the decisions of farmers in Kyrgyzstan and often forcing them to shift from the production of one crop to another.

Although the performance of the agricultural sector in southern Kyrgyzstan is apparently not affected by direct taxes and export tariffs, inefficiencies and low productivity in the agricultural sector still persist. Dependency on the uncertainties of world prices and a small domestic consumption market, in association with limited and ineffective use of modern agricultural inputs and technology, have contributed to the poor performance of the sector. The application of agricultural chemicals to crops was sharply reduced after 1992. The inadequate application of fertilizer is contributing to soil fertility decline, the low productivity of arable land, and the degradation of the resource base, which is detrimental to future generations. The high price of imported fertilizers and other chemicals is viewed as the most important factor limiting the use of these essential inputs. This situation is further exacerbated by the impact on input prices of the value-added tax (VAT) that is imposed on imported inputs.

In southern Kyrgyzstan the land reform began in 1991 when the Land Code established long-term leases of land for 49 years. The term of land lease was later extended to 99 years. Since that time, private farmers have begun leasing the land from collective and state farms (kolkhozes and sovkhozes). In 1999 a new Land Code established the right to private ownership of land. About 75% of the land was distributed to households, and the remainder belongs to the State. Short-term leasing of state land is for 5-7 years and medium-term leasing is for up to 10 years. Medium-term leasing agreements do not apply to irrigated land. Until recent years, seed-producing farms had been indirectly subsidized by paying only a small amount of land tax for using some of the state-owned national land.

To promote income distribution and social welfare, land ownership was restricted to residents of areas and villages. Although the new law was an important step in the privatization of agricultural land, a new market where land could be traded or used as collateral did not emerge as a result of this law.

The Law on Agricultural Land and Farms issued in 1999 provided a legal basis and framework for the establishment of the country's farms. As Table 1.1 clearly shows, agricultural production has substantially shifted from state-owned farms to private farmers and households that are key participants of a market-driven economy. In 1992 about 90% of grain production took place on state farms,

Table 1.1. Agricultural Production in Kyrgyzstan by Type of Farm in 1992 and 2002[a]

Crops	1992			2002		
	State	Private Farmers	Households	State	Private Farmers	Households
	('000 tons)					
Grains	1,368.0	83.0	65.5	343.3	1,446.3	163.2
Wheat	605.7	27.9	0.8	262.8	1,009.6	33.2
Barley	534.4	46.8	0.8	34.4	129.0	2.4
Maize	209.2	8.1	63.4	36.4	268.4	123.3
Rice	2.6	0.1	0.1	3.1	14.7	1.2
Sugar beet	125.0	9.4	0.2	125.2	374.1	25.2
Cotton	50.2	2.2	0.0	21.6	77.0	0.1
Tobacco	42.2	0.8	0.1	1.1	6.6	0.5
Vegetable oil crop	5.5	0.2	0.6	8.8	55.3	5.5
Potatoes	109.2	13.2	239.7	58.6	565.7	619.7
Vegetables	214.3	8.1	181.6	54.6	332.0	441.4
Melons	18.9	0.5	15.1	7.3	58.0	14.6
Fruits and berries	42.0	0.6	74.9	12.4	38.2	103.1
Grapes	24.5	0.0	6.5	2.3	4.5	10.8

a. Source: National Statistical Committee of the Kyrgyz Republic.

whereas in 2002 only 18% of the grain was produced by these farms and about 82% was produced by privately owned farms. The Law on Cooperation, which was issued that year, also enabled private landowners to associate and organize into legal cooperative groups and organizations. However, recent legislation (2003) that established a 20% VAT on agricultural output of farms and agricultural societies with revenues of more than 300,000 Soms/year, has become the main constraint to the creation of cooperative societies.

Overview of the Crops Evaluated in This Study

Wheat—Wheat is the most important crop produced in Kyrgyzstan, and in terms of crop area, it covers about 500,000 ha or about 36% of the country's agricultural land. However, the quality of the wheat grain is on average equal or worse than the grain produced in Kazakhstan and Russia. Winter wheat is the most preferred grain crop grown in the irrigated lands. The average yield of winter wheat is about 3.2-3.6 tons/ha, which is much less than its potential yield, and can be increased to up to 6 tons/ha. Although wheat is not considered a very profitable crop in Kyrgyzstan, it is produced for self-consumption and because of its socio-economic importance to farmers and the rural population. To meet the domestic demand, Kyrgyzstan regularly imports wheat from neighboring Kazakhstan and Russia.

Cotton—This is the second most important crop. It is the most exportable crop produced in Kyrgyzstan and accounts for about 20% of the cultivated area. Southern oblasts have favorable climatic conditions for cotton production. The price and profits of cotton production have been key determinants of the price and cost of renting land in southern Kyrgyzstan.

Maize—The production of maize has decreased in the past 10 years due to the decline in demand caused by the collapse of the livestock sector. In the early and mid-1990s, maize was primarily produced for silage, but in recent years maize has been grown for grain to be used as animal feed. Maize production accounted for about 6% of the agricultural land cultivated in 2002 compared with 9% in 1992.

Sunflowers—The production of oilseeds has increased in the past 10 years to meet the growth in demand for edible oil. Oilseeds are usually bought by small oil mills or processed at farms. Although the domestically produced oil has poor quality, most households prefer it because of its lower price. Sunflower oil is 3%-5% cheaper than cotton oil because consumers in southern Kyrgyzstan prefer the cotton oil.

Rice—Mostly small-scale household farmers produce this crop. Rice is considered one of the most labor-intensive crop production enterprises in Kyrgyzstan and machinery is rarely used. The production of rice is restricted to some areas with suitable supply of water and agro-climatic conditions. The area cultivated with rice was about 7,000 ha in 2002 compared with 1,000 ha in 1990.

Barley—This was the most important crop before independence and was produced mainly to meet the demand of the livestock sector. Barley was produced on about 44.1% of the agricultural land in 1990, but production has declined substantially accounting for only 6.2% of the cultivated area in 2002. Most agricultural land where barley was grown in 1990 is now being used for the production of grain such as wheat for human consumption.

Potatoes—Imports of potatoes have been reduced substantially in the past decade as a result of a significant increase in domestic production. Although potato yields have slightly improved compared with those of the 1990s, there is potential for significant expansion in potato yields and production as a result of improvements in technology and the favorable agro-climatic conditions that exist in southern Kyrgyzstan. Potato production in 2002 occurred on about 7.1% of the agricultural land, compared with only 2.1% of the area in 1990.

Tomatoes and Cucumbers—In developing low-income countries, consumers spend most of their income on staple food. The consumption of vegetables usually increases as a result of increases in income per capita and lower prices. Tomatoes and cucumbers are rarely produced on a large scale because they are perishable products, which are costly to keep in storage. The volatility of vegetable prices is very high compared with that of staple crops. Although household farmers produce tomatoes and cucumbers mainly for their own consumption, some vegetables are also imported from Uzbekistan. Greenhouse vegetable production is not well developed in southern Kyrgyzstan, and the domestic winter demand for vegetables is met through imports from Uzbekistan.

Onions—Onions are an important crop in southern Kyrgyzstan and are viewed as a commodity with a high socio-economic preference and value. The domestic demand for onion is very inelastic, which makes the production of this crop risky. Kyrgyzstan exports onions to Kazakhstan and Russia. The average yield of onions in southern Kyrgyzstan is about 40-45 tons/ha.

Watermelons—Watermelons are one of the traditional agricultural crops in southern Kyrgyzstan. Consumer attitudes toward watermelon are favorable, and it is primarily consumed during the harvest season when it tastes sweetest and prices are low. Greenhouse production of watermelon is not developed.

II. Principles of Comparative Advantage Analysis

Factor Endowments and Relative Prices

There have been efforts in some countries and areas of Central Asia to promote the mechanization of agriculture by facilitating the use of machinery at the expense of animal power. These attempts and efforts, however, have resulted in failures despite the intensity of funding. Nevertheless, agriculture has experienced a process of substitution and thereby evolving changes in the use of factors of production (labor, land, and capital). For example, cotton is no longer harvested with machines in southern Kyrgyzstan; this practice has been replaced with human labor. Changes in factor use intensity and in agricultural production technology are taking place in response to changes in the relative prices (costs) of those factors and gradual adjustments in factor endowments.

Comparative advantage analysis primarily relies on the concepts of opportunity costs, and its principles have been an integral part of trade theory. Through the production of internationally tradable goods attained by engaging the use of domestic capital, labor, and natural resources, a country can generate revenues and earnings of foreign exchange by exporting those goods, and saving by substituting imports. Measures of comparative advantage are necessary and useful information to guide the optimal allocation of resources and efficient specialization in the production of internationally tradable competitive products.

Labor in southern Kyrgyzstan is relatively abundant compared with the northern region. This is a marked characteristic affecting factor endowments in each region and the relative prices of labor with respect to other factors of production. Factor endowment concepts, introduced by Heckscher and Ohlin (H-O), stated that each nation could gain from the intensive use of their domestically abundant factors. The assumptions were that all nations have equivalent technology and differ in their endowments of resources (factors). The H-O theory was not only an explanation of trade but also provided grounds for government policies to strengthen competitiveness and specialization. Governments have often established policies to create environments that are conducive to maximize the benefits of their countries' resource endowments and comparative advantages. Although these policies have achieved important successes, they have not always been successful in promoting economic development and growth, and a number of countries are yet to implement these policies.

The H-O theory, however, does not provide sufficient explanation of the comparative advantage and actual trade patterns among countries because it did not consider other variables and circumstances affecting specialization in production and international trade, such as the qualitative characteristics of inputs and factors of production, and the dynamic nature of factor substitution. For example, it is apparent that a high rate of unemployment in southern Kyrgyzstan has resulted in significant factor intensity differences between large farms and household farms (Figure 2.1). Large farms that employ a combination of capital and labor incur and take into account the payment of wages for labor, while for most small-scale household farmers the opportunity return of their labor is associated with high levels of unemployment. This implies that although the cost of unskilled labor (wage rate) for large farms is about 7 Soms/hour ($0.15/hour), the cost of labor for the household farm is nearly zero. This situation shows how a dichotomy in the circumstances that farming enterprises confront can affect significantly the comparative advantage for the production of a crop. That is why the straightforward application of factor endowment principles is usually not sufficient to elicit practical and appropriate outcomes and implications for policy design. Despite its limitations, the H-O theory is still considered one of the most useful tools for the design of economic policy to promote trade and development in a country.

Economies of Scale

An analysis of comparative advantage in southern Kyrgyzstan should not ignore the influence that economies of scale can have on the competitiveness of activities and enterprises of agricultural pro-

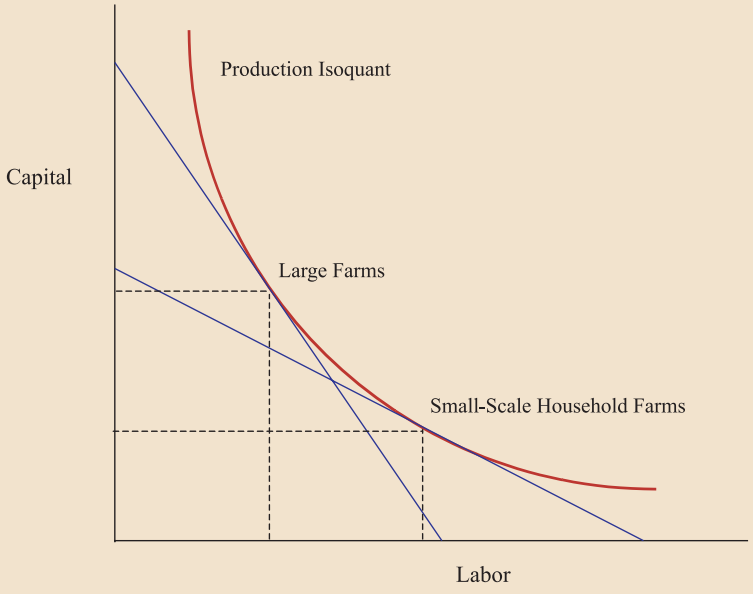

Figure 2.1. Relative Use of Capital and Labor by Large- and Small-Scale Farms in Southern Kyrgyzstan

duction. First, it is important to recognize that although the agricultural area of southern Kyrgyzstan is relatively small, economies of scale are apparent in some business enterprises. Second, the recently issued legislation, which requires farms with annual revenues of more than 300,000 Soms to pay value-added tax, discriminates against the size of business enterprises and the economies of scale gains that a larger size enterprise may attain. Third, large businesses in Kyrgyzstan can hardly operate as part of the underground economy and therefore have to pay the additional costs imposed by regulating agencies and all the costs associated with full transparency.

In applying concepts of factor endowments and comparative advantages, it is often assumed that enterprises have constant returns to scale. This means that if inputs were doubled, output would also double. However, in reality economies (increasing returns) and diseconomies (decreasing returns) of scale usually occur as production enterprises change the scale of operations.

External economies of scale are usually related to a whole sector or industry. Large-economy countries that have an important share in the market of a commodity often benefit from these economies because they are able to influence prices. Small- and medium-size economies, such as that of Kyrgyzstan and most countries of Central Asia, which participate individually in the international market, cannot benefit significantly by this type of economy of scale.

An important objective of the Law on Cooperation issued in 1999 was probably to provide incentives for farmers to associate and cooperate to improve efficiency in the use of resources and increase competitiveness and profitability. Internal economies of scale have implications for the performance of individual farms and enterprises and also for Kyrgyzstan's economy; these implications are important to address and analyze. Such analysis is, however, beyond the scope of this study.

In regard to imports of inputs, in general, and agricultural inputs, in particular, it is important to note that quantities demanded of imported inputs are sensitive to changes in import tariff and other indirect policy distortions. An example of this situation is illustrated in Figure 2.2, where the flow of illegally imported subsidized agricultural chemicals from Uzbekistan causes a shift (decrease) in the demand for high-quality certified inputs, which are legally imported and supplied by legal businesses from D1 to D2. Then, if a valued-added import tax on legal agricultural chemicals is also imposed, the average cost of these inputs could shift upwards (from Social AC to Private AC in Figure 2.2) to actually eliminate the demand for legally imported inputs.

Returns of Skills and Education

Economists in recent decades have argued that the factors determining the comparative advantage of a country are not only inherited but also created as a result of technical innovation and human resource development. Improvements in technology and a population embodied with skills, education, and knowledge are increasingly important factors

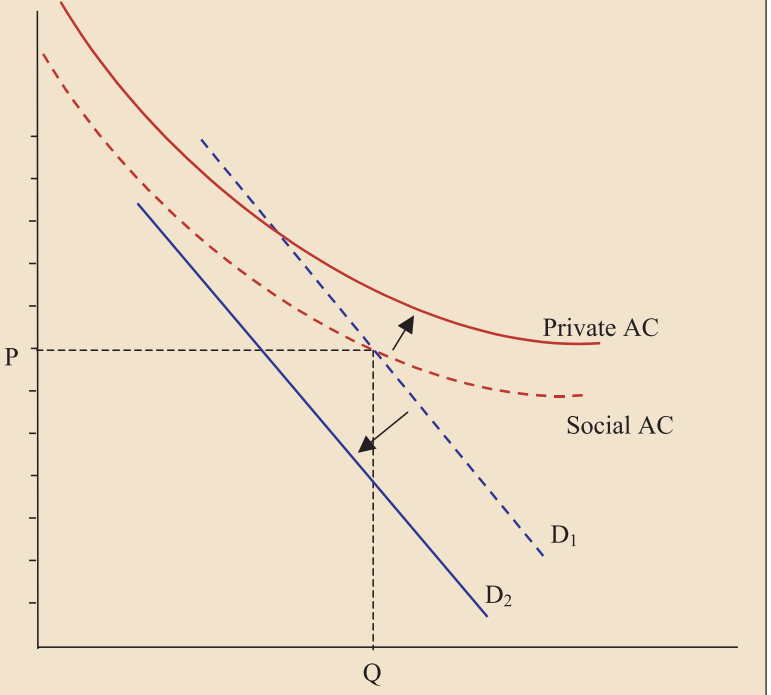

Figure 2.2. Impact of Illegal Imports of Agricultural Inputs and of a VAT to Imports of Inputs

affecting the comparative advantage of a nation to produce and compete in the international market. Considering the rapid pace of change and innovation in technology, these factors are becoming more and more important.

Recent research shows that most of the farmers in southern Kyrgyzstan (40%-50%) are not traditionally farmers but rather became farmers after the collapse of the Soviet Union. As a result of this event, many farmers in southern Kyrgyzstan were poorly skilled in the beginning. Improvements in the productivity of agriculture in recent years appears to be due mainly to improvements in the skills of farmers and farm workers involved in agricultural production in southern Kyrgyzstan. However, better agronomic skills obtained through "learning-by-doing" were not the only factors contributing to such improvements in productivity. New skills in entrepreneurial proficiency, financial management, marketing, and risk management acquired by qualified labor are also essential features of the development that has taken place since the transitional reforms began. Thus, programs and efforts to educate and train business entrepreneurs should be considered when the development of transitional economies is addressed. Human resource development involves improvements in diverse skills that are essential to achieve economic growth and development.

Comparative Advantage and Competitiveness

It is important for governments of developing countries to understand the nature of these two concepts so that they are not misled by the illusion of apparent comparative advantages that a country may have. In recent decades, there has been some debate about the definition of these two concepts and their importance. According to Warr (1994), competitiveness indicates the commercial performance of a firm in domestic or world markets under current prices, policies, and market circumstances, whereas the concept of comparative advantage is related to the efficient allocation of resources in a region or country. In estimating and evaluating comparative advantages, all policy and market distortions can be accounted to properly identify potential opportunities for using national resources most efficiently, that is, to achieve the most efficient allocation of national resources. For example, a country may not have a comparative advantage in producing a particular commodity, but domestic firms may be competitive and commercially successful producing that commodity due to government subsidies or high import tariffs.

Conceptually in a world of fully homogenous products, competitiveness and comparative advantage would converge, and price competition would be expected when all policy distortions and market failures are removed. However, differences between comparative advantage and competitiveness indicators are not explained only by policy distortions and market failures but also by factors that cause real or perceived product differentiation. Aspects of

product quality, packaging, and marketing strategies are some of the factors that attempt to remove the homogenous product assumption of perfect competition. In other words, comparative advantages may be viewed as indicators of "possibilities and potential," whereas competitiveness represents "realizing those possibilities and potential."

Differences in the nature of the competitiveness and comparative advantage concepts have provided new arguments to issues of international trade. In his book *The Competitive Advantage of Nations,* Porter states that the paradigm of comparative advantage has changed. He says, "Ironically, just as the theory of comparative advantage was being formulated, the Industrial Revolution was making some of its premises obsolete. As a larger number of industries became more knowledge-intensive in the post-World War II period, the role of factor costs has weakened even further" (p. 13). If we were to consider this argument, is it really worthwhile to analyze comparative advantages of crop production in southern Kyrgyzstan? Porter says, "Factor costs remain important in industries dependent on natural resources, in those where unskilled or semiskilled labor are the dominant portion of total cost, and in those where technology is simple and widely available." Countries of Central Asia, including Kyrgyzstan, are quite congruent with the "industries" defined here.

III. Methodological Framework

Policy Analysis Matrix

The method of analysis used in this study is the Policy Analysis Matrix (PAM) approach, developed by Monke and Pearson (1989). The PAM framework has been used as a tool for policy analysis and development in a number of developing countries and transitional economies. The PAM is a flexible method that can be used to evaluate the comparative advantage of a specific project, production and business enterprises, and for policy analysis.

The PAM consists of two accounting identities (Table 3.1). The first identity is profitability—D and H—the difference between the revenues and costs in terms of private and social prices. The second identity is divergences—I, J, and K—to measure the effects of government policy and market failures, or in effect, the difference between the observed and the social (economic) prices.

Private Prices—The first row of PAM estimates the private profitability of a production system from observed revenues, costs, and profits. All the data of the first row reflects actual market prices at a given location and time. The private prices of input and output of agricultural production enterprises consist of the economic value and the policy or market failure effects. The private price components of the PAM are derived from farmers' budgets, and the data are not necessarily the same as the data of any particular individual farmer. The lack of proper information on world prices, poor entrepreneurial skills, the qualitative characteristics of inputs and outputs, profit margins of intermediary traders and processors may bias the prices that farmers pay for inputs or the income they receive. Therefore, average import and export parity prices for products may differ from those in actual budget prices.

Because we are comparing systems or enterprises producing agricultural commodities with different intensities of factor use (ratios), it is important to decompose the budget structure of each production system under study and estimate additional indicators or measures of profits and costs, which include net profit, gross margin, variable costs, financial return, and skilled and unskilled labor employed. All these indicators are important since a production system may be very profitable for farmers but inefficient in terms of the domestic use of resources by the country and society as a whole.

Social Prices—Actual market prices sometimes do not represent the real value (price) of scarce resources. The bias in prices may be caused by government intervention (policies) or market failures.

Table 3.1. The Policy Analysis Matrix

	Revenue	Tradable Input Costs	Domestic Factor Costs	Profits
Private Prices	A	B	C	D=A-B-C
Social Prices	E	F	G	H=E-F-G
Divergences	I=A-E	J=F-B	K=G-C	L=D-H=I-J-K

Ratio indicators for comparison and analysis are:

Private Cost Ratio (PCR) = C/(A - B)
Domestic Resource Cost Ratio (DRC) = G/(E - F)
Nominal Protection Coefficient on Tradable Output (NPC) = A/E
Nominal Protection Coefficient on Tradable Input (NPC) = B/F
Effective Protection Coefficient (EPC) = (A - B)/(E - F)
Subsidy Ratio to Producers = L/E or (D - H)/E

That is why it is important to estimate the social prices, that is, prices that reflect the true value or the opportunity cost of resources. In general, defining the social prices that should be used to calculate social costs/values is considered the most challenging task that must be conducted in PAM analysis. There are many ways of calculating social prices depending on the nature of each good. World prices are considered the most practical reference for the case of internationally tradable goods and serve as a basis for estimating import and export parity prices as an inherent part of social price calculations of tradable goods: c.i.f. prices are normally used for imported inputs and f.o.b. prices for the case of exportable goods.

The calculation of domestic factor prices, however, requires methods of estimation that are not based on world prices. Social prices for domestic factors are usually calculated by using methods such as opportunity costs, net income forgone, willingness to pay, etc. Also, difficulties and easiness for domestic factors to be moved or shifted across regions within a country and across international borders are considered in calculating social prices. Capital and labor are relatively mobile domestic factors that can be shifted to sectors of the economy other than agriculture. The prices of the more mobile domestic factors are determined by aggregate demand and supply, and their opportunity costs can be found in other sectors such as transportation, industry, and services. Social prices for the less mobile factors are usually determined by supply and demand within the sector where they are used and also within a well-defined geographic area.

Land is considered an immobile factor, and the opportunity cost used to calculate the social cost/value of land is obtained by estimating the returns to land in alternative crops or other uses. The estimation of social prices of land by calculating returns to the use of land with alternative crops may result in the miss-estimation of prices, because not only profit but also other indicators such as risk and intensity of capital use are important circumstances that must be considered. Because market forces in southern Kyrgyzstan normally determine rental prices for agricultural land, the private and social prices of land in this region do not differ much from each other. In general, social prices should reflect the true value of goods.

Divergences—The second identity of the PAM concerns the divergence or difference that exists between private and social prices. These divergences are shown on the third row of the matrix and occur as a result of government policies and market failures. Policies that are often established to generate revenues to support efforts for promoting income distribution, food security, and improved education cause these divergences and inefficiencies in resource use. The third row of the PAM would show zeroes if there were no divergences, that is, if all policy interventions and market imperfections were removed. Differences between private and social prices are usually explained by the effects of some combination of policy interventions such as trade restrictions, price controls, tax imposition, subsidies and exchange rate controls. For instance, a VAT on imported agricultural products (outputs) can result in higher private revenue to the producers of those products. This causes a positive divergence in revenues (I) due to the protection that the VAT provides to the domestic production of a given crop.

PAM Ratios and Their Interpretations

Nominal and Effective Protection Coefficients—The nominal protection coefficient (NPC) and the effective protection coefficient (EPC) are indicators or measures of policy distortions. The NPC measures the distortion caused by a policy or policies on a single input or output market. It is, in fact, the ratio of the domestic price to the relevant import or export parity price. The EPC measures the combined effect of distortions in the output and tradable input markets for a given production system. It is the ratio of the value added, calculated in terms of domestic prices, to the value added, calculated in terms of world prices. An EPC lower than one implies that the net effect of current policies is the equivalent of "taxation" on the domestic production system, whereas an EPC greater than one implies that the net effect of current policies is the equivalent of a "subsidy" to the domestic production system.

Domestic Resource Cost Ratio—Although the profitability of alternative agricultural production systems provides a measure for assessing the relative profitability of those systems, the evaluation of net returns (profitability) per unit of land area is sometimes complicated by the fact that the activities/production systems that we are comparing may differ greatly in their intensity of input use. To facilitate those comparisons, the information used for the economic profitability analysis is also used to calculate domestic resource cost (DRC) ratios for different crops. The DRC ratio is based on the social costs and value of inputs and outputs, and it is calculated by considering distortions caused by policy interventions and market failures. The DRC compares the opportunity costs of domestic resources used in a production system calculated in terms of international prices to the value added of the production system calculated at international prices. The DRC is an indicator of the comparative advantage of a production system. Production systems with DRC ratios lower than one are considered to have comparative advantages to use efficiently the resources of a country or region. The lower the DRC ratio, the better is the comparative advantage of a production enterprise or system.

Limitation of PAM Methodology—The PAM method is an analytical procedure that provides indicators of comparative advantage at a given point in time and under a given set of circumstances. It is, therefore, a method for static analysis that fails to account for the dynamic consequences of changes over time in input and output prices, new quantities of output and inputs, and changes in the cost structure of production systems and enterprises. The PAM method, through sensitivity analyses, can be used to calculate the relative short-run direct effects of price changes to economic profitability but cannot provide estimates on the dynamic effects of price changes on the rates of inputs application and demand. The input-output budgets that are specified on the basis of data from recent years can be appropriately adjusted to assess the short-run impact of changes in policy and prices. However, expected changes in the structure of costs and budgets due to changes in policy and prices are not accounted for. The estimation of those changes requires a more elaborate analysis of supply and demand that is beyond the usual scope of the PAM methodology.

The PAM approach requires a substantial quantity of data for analysis, especially at the farm level. One of the main obstacles for conducting economic research in Kyrgyzstan and other Central Asian countries is to examine a diversity of often-biased sources of data. To conduct this study, alternative sources of data and information were investigated and farmers, and representatives of related sectors were interviewed to obtain better quality data. The agricultural sector of southern Kyrgyzstan consists mainly of private farms and small-scale household farms involved in subsistence farming. Aggregate data on agricultural land use and crop yields were obtained from the statistical records departments of Osh, Jalal-Abad, and Batken Oblasts. Quarterly prices for agricultural products and exchange rates for Osh (Kyrgyzstan), Andijan (Uzbekistan), and Almaty (Kazakhstan) for 1998-2002 were obtained from KAMIS Ltd. Estimates of crop yields and input use coefficients for various crops were obtained from farmers interviewed in a survey of farmers conducted in three southern oblasts. The data collected primarily pertained to the 2002 production year.

Assumptions and Considerations

Farm Sub-Sectors and Enterprises—Three types of farms managed by agricultural producers or farmers characterize the three identifiable farm sub-sectors that are evaluated in this study; namely, the sub-sectors of small-scale household farms, average-scale farms and large-scale farms. The types of farms that are typical of each sub-sector are: (1) the small-scale household farms are managed by farmers that own 1 ha or less of land, use machinery only to plow, and conduct farming activities using essentially their family labor only; (2) the average-scale farms operated by farmers that on average rent 5 ha of land, pay rent at market rates, and hire out-of-farm labor and machinery services; and (3) the large-scale farms operated by farmers managing 200 ha of land, employ their own machinery and have to pay for administrative and overhead costs. The household and average-scale farms have to pay for operating variable costs only, whereas

large-scale farms have to pay for fixed costs also. An average distance of 40 km from the farmland to the marketplace is assumed for the three types of farms. Thus, transportation costs for the delivery of inputs and outputs are based on the volume of inputs and outputs and the average distance of 40 km.

The types of farm-crop enterprises that are included in the PAM evaluation are presented in Table 3.2. The main crops included in the analysis are cotton, wheat, maize, rice, barley, and sunflower; and the vegetable crops included are tomato, watermelon, onion, potato, and cucumber. Greenhouse production enterprises were included also for tomato, watermelon, and cucumber.

Land—Agricultural land is a fixed immobile factor of production, and its market price and value is seldom affected by changes in other sectors of the economy. The true value of land is calculated by its opportunity cost (return), which, as is noted before, also depends on a number of other factors such as its intensity of use, the use of capital and modern inputs and technology, and the risk of the production activity. Therefore, the comparison of crop production enterprises with different levels of risk and returns should consider both sources of differences and should be treated with caution. The current policy on the land used by seed-producing farms causes a wide gap between the true economic value and the actual undervalued price of the land paid by these large farms. Farmers operating former government seed-producing enterprises on large farms in southern Kyrgyzstan pay a land tax of only 450 Soms/year/ha, which does not reflect the true economic value of land. However, average-scale farmers do not have such privileges and have to pay rent for land on a competitive basis, which can be as high as 15,000 Soms/year/ha.

Tradable Factors—Because prices for the most tradable factors (inputs) are distorted by VAT on imported inputs and also by subsidies in Uzbekistan, social prices for tradable inputs are calculated on the basis of world prices and in some cases on the basis of prices in the nearest potential country of supply. The dominant role of the illegal underground input supply in Kyrgyzstan that is smuggled from Uzbekistan is a source of additional difficulties in establishing proper assumptions to conduct this PAM evaluation. Many farmers purchase smuggled and illegally supplied inputs from Uzbekistan at a price that is often a great deal lower than the world price. The supply of illegal inputs is limited mainly to nitrogenous fertilizers and crop protection products (CPPs) for cotton. Because the supply of illegally imported inputs is so widespread, legal importers confront unfair competition and serious challenges in marketing and selling the legal agricultural inputs after paying the VAT. Prices of the legally imported agricultural inputs were used to calculate private prices and crop budgets used in the PAM evaluation. A summary of the import parity prices calculated for tradable inputs is presented in Appendix C.

Capital—Capital is very scarce in Kyrgyzstan and the newly independent states. Also, the banking system is one of the weakest links in the whole economy due to various policies, socio-economic circumstances, and cultural values. Commercial interest rates were about 33%-36% in 2002 whereas interest rates on deposits were 9%-12%. KAFC, a World Bank-supported institution, provides agricultural loans with an annual rate of 18% interest. Because of apparent interest rate discrimination in the transitional and emerging capital market, the social price (cost) of capital was estimated from the point of view of access and tradability in the relevant market. If capital is considered as a domestic factor, then the social interest rate of 33%-36% could be adopted because it may be viewed as the equilibrium interest rate in the market for commercial credit. Moreover, because interest rates in 2002 were usually higher for other sectors in Kyrgyzstan, an interest rate of 33% could have been taken as the social interest rate in this study. However, capital may be exported and imported and thus moved across international borders, and interest rates in international markets are substantially lower than 33%. The wide gap that exists between interest rates in international capital markets and the interest rate in Kyrgyzstan is primarily explained by a poor banking system, policy distortions and market failures, and risks and uncertainty. Considering the circumstances discussed here and the fact that interest rates in most

Table 3.2. Types of Farm-Crop Enterprises Included in the PAM Evaluation

	Household Small-Scale Farms			Average-Scale Farms			Large-Scale Farms			Greenhouse Enterprises		
	Non-tradable	Export (Almaty)	Import (Andijan)	Non-tradable	Export (Almaty)	Import (Andijan)	Non-tradable	Export (Almaty)	Import (Andijan)	Non-tradable	Export (Almaty)	Import (Andijan)
Main Crops												
Cotton					(Europe)			(Europe)				
Wheat	X		(Almaty)	X		(Almaty)	X		(Almaty)			
Maize	X	X	(Almaty)	X	X	(Almaty)	X	X				
Rice				X	X	X						
Barley				X			X		X			
Sunflowers	X			X			X					
Vegetable Crops												
Tomatoes	X	X	X	X	X	X				X		X
Watermelons	X	X	X	X	X	X				X		X
Onions	X	X	X	X	X	X						
Potatoes	X	X		X	X							
Cucumbers	X									X		X

capital abundant countries are lower than 9%, a social interest rate of 9% is adopted and used in this study.

Regarding the policy of interest rate discrimination, it is important to note that the policy of reducing interest rate to favor a particular sector of the economy may not result in the best allocation of capital resources and could delay the development of other sectors in the economy, for example, the manufacturing sector.

IV. Private and Social Profitability Results

Estimates of comparative advantage indicators for the selected farm-main-crop enterprises representing the three selected scales of farm operations are presented in Tables 4.1, 4.2, and 4.3. These estimates are calculated using average 1999-2002 output prices corresponding to import parity, non-traded commodity, and export parity situations. Estimates of private and social profits of each farm-crop enterprise in Soms per hectare are presented in these tables as indicators of profitability. Also, DRC ratios showing the total cost of domestic resources that are required to generate a net marginal unit of foreign exchange are estimated and used to rank the farm-crop enterprises by their comparative advantage. Farm-crop enterprises with estimated DRC ratios lower than 1 are relatively efficient and have comparative advantage to use the domestic resources of a region or country. The degree of efficiency and comparative advantage is determined by the DRC ratios, the smaller the DRC ratio is, the better is the comparative advantage of the farm-crop enterprise.

Main Crops

About 85% of the agricultural land of Kyrgyzstan is used for the production of "main crops," such as wheat, cotton, maize, and rice. To assess the comparative advantage of these crops, estimates of private and social profits and DRC ratios of the selected farm-main-crop enterprises were calculated at alternative trade and pricing assumptions and are presented in Table 4.1. Because only a limited number of small-scale household farms are involved in growing cotton, rice, and barley, estimates for these crops in household farms are not included in this table. Also, estimates for the rice crop enterprise on large-scale farms are not included because rice is rarely grown in these farms due to its management requirement and labor intensity. Because it is assumed that grain could be imported from Kazakhstan and vegetables from Uzbekistan, appropriate import parity estimates are calculated for these crops.

Wheat—Low prices of wheat in recent years have been forcing farmers in Kyrgyzstan to shift to other crops. The increased and more competitive production of wheat by Russia and Kazakhstan's reenergized agricultural sectors has contributed to the lower prices of grains in the region. Thus, although wheat is efficiently produced, it has the least comparative advantage after barley among the selected main crops. DRC ratios for household and average-scale farms at import parity prices (0.62 and 0.65, respectively) are somewhat higher than at non-traded parity prices (0.60 and 0.63, respectively) which implies that household and average-scale farms may not have a clear (DRC ratios are similar) comparative advantage to substitute imported wheat from Kazakhstan. Although large-scale farms with DRC ratios of 0.65 in wheat production appear not to offer the best use of domestic large-scale farm resources, the production of wheat by these farms may still be viewed as an efficient way to partially substitute imports (DRC less than 1). Estimates shown in Table 4.1 also indicate only a moderate financial and economic profitability of wheat for all scales of farm operations. It should be noted that because household farms do not pay rent for land they have higher net private profits per hectare than the average and large-scale farms. Also, it should be pointed out that about 15%-25% of grain is lost during harvesting due to the use of old harvesting machines such as "Niva" in southern Kyrgyzstan. New modern high-quality harvesting equipment costs about US $170,000-200,000, which cannot be purchased even by the largest farms due to financial constraints. Moreover, it would probably be inefficient to use this expensive machinery if wheat is not grown properly and on a large scale. However, by using high-quality, expensive machines efficiently, Kazakhstan and Russia have benefited by reducing grain losses during harvesting and through other advantages that mechanization provides.

Cotton—Cotton has always been the most tradable crop in Kyrgyzstan and is grown primarily to be exported unprocessed since the countries' cotton-ginning companies have very limited capacity to process cotton at harvesting season. Also, it should be noted that cotton in Kyrgyzstan is mostly traded

Table 4.1 Private and Social Profitability, and DRC Ratios of Main Crops in Southern Kyrgyzstan Based on Average 1999-2002 Output Prices

	Net Private Profit (Non-Traded)	Net Economic (Social) Profit				DRC Ratios			DRC Ranking		
		Kazakhstan Import Parity	Uzbekistan Import Parity	Non-Traded	Kazakhstan Export Parity	Import Parity	Non-Traded	Export Parity	Import Parity	Non-Traded	Export Parity
	(Soms/ha)										
Households											
Wheat	9,282	4,637	-	5,006	-	0.62	0.60	-	6	4	-
Cotton	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	-	-	-
Maize	16,068	17,167	-	11,727	5,007	0.32	0.41	0.62	1	3	5
Sunflowers	17,349	-	-	12,323	-	-	0.40	-	-	2	-
Barley	-	-	-	-	-	-	-	-	-	-	-
Average-Scale Farms											
Wheat	3,442	4,297	-	4,666	-	0.65	0.63	-	10	9	-
Cotton	14,074	-	-	16,507	24,580	-	0.47	0.37	-	6	3
Rice	32,860	-	11,838	33,664	25,114	0.61	0.35	0.42	8	1	4
Maize	9,768	16,367	-	10,927	4,207	0.35	0.45	0.68	2	5	11
Sunflowers	10,249	-	-	10,723	-	-	0.48	-	-	7	-
Barley	-2,479	-	-	-950	-	-	1.14	-	-	12	-
Large-Scale Farms											
Wheat	4,529	4,297	-	4,393	-	0.65	0.65	-	6	7	-
Cotton	15,913	-	-	16,986	25,059	-	0.45	0.36	-	4	2
Rice	-	-	-	-	-	-	-	-	-	-	-
Maize	11,105	16,344	-	10,904	4,184	0.35	0.45	0.68	1	3	8
Sunflowers	10,324	-	-	9,438	-	-	0.54	-	-	5	-
Barley	-1,219	-	-	-1,050	-	-	1.15	-	-	9	-

Table 4.2. Private and Social Profitability and DRC Ratios of Vegetable Crops in Southern Kyrgyzstan Based on 1999-2002 Output Prices

	Net Private Profit (Non-Traded)	Net Economic (Social) Profit			DRC Ratios			DRC Ranking		
		Uzbekistan Import Parity	Non-Traded	Kazakhstan Export Parity	Import Parity	Non-Traded	Export Parity	Import Parity	Non-Traded	Export Parity
	(Soms/ha)									
Households										
Potatoes	53,225	71,868	44,701	45,951	0.19	0.28	0.27	11	14	13
Tomatoes	60,897	78,071	57,071	224,371	0.12	0.16	0.05	6	9	1
Onions	74,192	105,020	65,645	136,295	0.15	0.22	0.12	8	12	5
Watermelons	70,794	108,828	65,928	131,029	0.08	0.14	0.07	4	7	2
Cucumbers	60,682	144,156	55,756	-	0.08	0.18	-	3	10	-
Average-Scale Farms										
Potatoes	38,225	66,085	39,701	40,351	0.25	0.36	0.35	10	14	13
Tomatoes	49,997	72,671	51,671	218,971	0.18	0.24	0.07	6	9	1
Onions	54,392	95,220	55,845	126,495	0.23	0.34	0.18	8	11	5
Watermelons	59,174	103,908	59,808	126,108	0.13	0.22	0.11	4	7	2
Cucumbers	47,662	136,636	48,236	-	0.12	0.29	-	3	10	-

Table 4.3. DRC Ratios and Private and Social Profitability of Greenhouse Vegetable Crops in Southern Kyrgyzstan. Based on Average 1999-2002 Output Prices

	Net Private Profit (Non-Traded)	Net Economic (Social) Profit			DRC Ratios			Ranking by DRC Ratios		
		Uzbekistan Import Parity	Non-Traded	Kazakhstan Export Parity	Import Parity	Non-Traded	Export Parity	Import Parity	Non-Traded	Export Parity
	(Soms/ha)									
Tomatoes	312,160	287,157	323,167	-	0.18	0.15	-	4	2	-
Cucumbers	322,099	321,604	332,967	-	0.17	0.15	-	3	1	-
Watermelons	2,469	6,719	6,969	-	0.79	0.79	-	6	5	-

at f.o.b. prices. Kyrgyz cotton is classified on Liverpool basis as "Index A" and essentially priced the same as Uzbek cotton. The price for Kyrgyz cotton may vary ±5% depending on the quality of the cotton.

If we do not consider the indicators of comparative advantage for import substitution, estimates of DRC ratios for cotton show that this crop is the most efficient crop to use domestic resources at export parity prices but comes after rice at non-traded parity prices. DRC ratios calculated at export parity prices and on a non-traded basis are 0.37 and 0.47 respectively, for average scale farms, and 0.36 and 0.45 for large-scale farms. The difference between cotton's DRC ratios calculated on the basis of export parity and a non-traded product can be explained by the lack of access to information on the world market for cotton and the presence of only a limited number of buyers in the cotton market of Kyrgyzstan. Large-scale farms have a greater comparative advantage in producing cotton than average-scale farms. As described below, the advantage of large-scale farms is partially explained by differences in intensities of factor use (labor and capital).

Rice—Rice is grown primarily on average-scale farms, but the average size of land employed in rice production rarely exceeds 1 ha. Since rice requires intensive water management, it is produced only in selected areas of agricultural land where water is available in sufficient quantities. The private and economic costs of land and water in these rice areas are approximately twice as high as the costs of these resources in the average irrigated land areas. Estimates shown in Table 4.1 indicate that when compared with other crops, private and social profits of rice calculated using non-traded parity prices are considerably higher than when import parity prices are used. Economic profitability under import parity prices is considerably lower (11,838 Soms/ha) than under non-traded parity prices (33,664 Soms/ha). DRC ratios under import and non-traded parity prices are 0.61 and 0.35, respectively, and indicate that Kyrgyzstan does not have a strong relative comparative advantage to produce rice for import substitution. When rice profitability is compared with the economic profitability estimates of other crops, it is apparent that the country does not have any more profitable alternatives among main crops than the production of rice as a non-traded commodity. Although the economic profitability of rice production at export parity prices is smaller than on a non-traded basis (DRC ratio of 0.42 versus 0.35), it would still be very profitable to export rice in case of domestic over-production to stabilize the domestic price of this commodity.

Maize—In the past, important land resources were allocated to the production of maize for grain and as forage. However, the collapse of the livestock sector has seriously hindered the demand for this crop. The economic efficiency of maize production depends mainly on the development of the livestock sector. As shown in Table 4.1, maize has the best (lowest) DRC ratios calculated on the basis of import parity prices, namely 0.35 for average and large-scale farms and 0.32 for household farms. Thus, maize is apparently the crop that uses domestic resources more efficiently to substitute imports, which means that maize imports should be avoided. The profits and DRC ratios of maize calculated on the basis of a non-traded commodity (0.45 for average and large-scale farms) should be considered as representative of the type of domestic market for maize that farmers will actually confront. It should be noted that large-scale farms have a slight advantage in maize production over average-scale farms. The DRC ratio of less than 1 at export parity prices (0.68) implies that in southern Kyrgyzstan there are better alternatives to use resources than in maize production for exports to Kazakhstan. Southern Kyrgyzstan could potentially produce maize seeds for exports. This, however, is a different type of enterprise, and its success will depend not only on natural resource endowment but also on technical innovation and human resource development.

Sunflowers—Sunflowers are produced to meet the demand for edible oil in Kyrgyzstan. Although cotton oil is preferred over sunflower oil, because it is a byproduct of cotton production the supply of cotton oil is not driven by market demand. It is estimated that annual consumption of oil in southern Kyrgyzstan is about 7-9 liters per capita, and the production of cotton oil is not sufficient to meet domestic demand. Sunflowers are produced to meet the excess demand for oil. The domestically pro-

duced sunflower oil is primarily processed in rural areas with small-scale machines and is of poor quality. The price of domestically produced sunflower oil is 3%-5% lower than cotton oil and 15%-25% lower than high-quality imported sunflower oil. As is shown by the profitability indicators and DRC ratios calculated on a non-trade commodity basis that are presented in Table 4.1, sunflower production has a comparative advantage in the use of domestic resources over the production of wheat and barley in all three scales of farm operation.

Barley—The decline of barley production in southern Kyrgyzstan in recent years has taken place as a result of the failure and breakdown of the livestock sector. Although the low profitability of barley production is well recognized, some large-scale and average-scale farms grow this crop as a component of a crop mix used in low-value land. The estimates of profitability presented in Table 4.1 show that barley is the only unprofitable crop among the crops included in this analysis. Estimates of private and social profits of barley are negative for average- and large-scale farms. Private and social profits of barley on large-scale farms were -1,219 Soms/ha and -1,050 Soms/ha, respectively, with a DRC ratio of 1.15. Thus, under current circumstances it is apparent that the production of barley is unprofitable in southern Kyrgyzstan and results in the inefficient use of resources.

Vegetable Crops

In southern Kyrgyzstan vegetable crops usually have been very profitable but are also associated with sources of risk and uncertainty. While main crops such as cotton and wheat have DRC ratios greater than 0.40 at non-trade parity prices, vegetable crops have DRC ratios that are lower than 0.36. However, the apparent high comparative advantage of vegetable crop production indicated by these estimates should not create the illusion of being the "most-profitable crops." The gap between comparative advantage and potential competitiveness for main crops can be explained mainly in terms of policy and market distortions. However, for the case of vegetable crops, circumstances are quite different and the removal of policy distortions by itself usually do not improve significantly the competitiveness of vegetable crop production. Vegetable crops unlike main crops require much more effort and costs in the processing and marketing of products to gain access to markets and compete effectively in those markets. This is one of the reasons why the results of the comparative advantage indicators of this analysis are presented separately for main crops and vegetable crops. There are also other reasons that justify different considerations in the analysis and presentation of results for the case of vegetable crops. Some of these reasons are differences in relative factor use intensities, the special crop management demands of vegetable crops (pest and disease control and harvesting), and differences in the degree of uncertainty about output prices and crop yields.

Vegetable crops are primarily produced on household farms and average-scale farms. The comparative advantage of household farms in vegetable production is explained by the low economic (social) cost of family labor that approaches zero due to unemployment and the lack of opportunities outside the farm. All vegetable-crop enterprises show lower DRC ratios at import and export parity prices than at non-traded parity prices. These results imply that there is a potentially high comparative advantage of vegetable crop production in southern Kyrgyzstan for import substitution and export promotion that should be further evaluated.

Potatoes—Areas with agro-climatic conditions favorable for potato production are limited in southern Kyrgyzstan. Some regions of the Osh Oblast such as the Noukat, Uzgen, Alai, and the Chon Alai regions have favorable agro-climatic conditions for potato production. The private and social prices of land with these conditions are almost twofold the price of average irrigated land in southern Kyrgyzstan.

Estimates of DRC ratios presented in Table 4.2 show that for average-scale farms the DRC ratio of potato production as a non-traded commodity is 0.36, whereas for import substitution and export promotion the DRC ratios are 0.25 and 0.35, respectively. DRC ratios of potato production by small-scale household farms are even lower than those of average-scale farms, that is, DRC ratios of 0.28, 0.27, and 0.19 at non-traded, export parity, and import

parity prices, respectively. Although potato production shows the highest DRC ratios among all the vegetable crops included in the analysis, its importance should not be underestimated and overlooked. The unaccounted advantage that the potato crop has over other vegetables in terms of its storability and marketability can easily compensate for the somewhat higher (worse) DRC estimates reflecting the comparative advantage of potato production.

Tomatoes—Estimates of profitability and DRC ratios presented in Table 4.2 show that tomato production has the highest comparative advantage at export parity prices with an estimated economic profit of 224,371 Soms/ha and a DRC ratio of 0.05 for household small-scale farms. However, as a non-traded commodity the estimated economic profits of tomato production are only about one-fourth of the profits at export parity prices but still in quite a strong comparative advantage. The large difference in profits is explained by the problems and costs associated with the transportation, storage, and marketing of tomatoes in the domestic market including the volatility of this market and the perishable nature of this product. Moreover, estimates of the comparative advantage of tomatoes in the export market shown here should be viewed with extreme caution because some factors and costs such as those associated with the lack of information and poor experience of farmers and entrepreneurs in Kyrgyzstan in exporting vegetables have not been properly accounted for in these estimates. Uncertainty and volatility in the vegetable export markets also exist. Lack of knowledge, experience, and access to information and proper technology are some of the key difficult constraints that must be overcome in export-promotion development. Some of these constraints may be relaxed, for instance, through the use of hybrid seeds supplied by seed companies that are now operating in Kyrgyzstan such as Nunhems, SVS, and Syngenta.

Onions—Although the production of onions as a non-traded commodity has greater private and economic profits than tomatoes, estimates of DRC ratios presented in Table 4.2 for both crops show contrasting and somewhat opposite results due to the higher price of land used in onion production. Again, as is the case for all the other vegetable crops included in this analysis, at export parity prices onion production has considerably smaller DRC ratios (more profitability) than at non-traded commodity prices. For average-scale farms the estimated DRC ratios of onion production are 0.34 and 0.18 at non-traded and export parity prices, respectively. However, as indicated before for tomatoes, exports of vegetables are associated with high risks and involve additional marketing and management that are not accounted for in this analysis.

Watermelons—Watermelons appear to have a strong comparative advantage especially at export parity prices where the estimated economic (social) profit is more than twice as large as the one estimated at non-traded parity prices (126,108 versus 59,808 Soms/ha). Also, the estimated economic profits of watermelon production are quite high when import substitution is considered. Unlike tomatoes and cucumbers, watermelons can be stored for a longer period of time. However, during winter the consumption of watermelons declines substantially due to the cold weather.

Cucumbers—Although estimates of private and social profits of cucumber production are quite high, cucumbers are rarely grown on a large scale because of the serious problems and losses that farmers have to confront in handling and marketing the product. Among all the vegetable crops included in this study, cucumbers are probably the most difficult product for farmers in Kyrgyzstan to market. As is the case for all the vegetable enterprises considered in this study, the production of cucumbers has a high comparative advantage for import substitution. Cucumbers are usually grown by small-scale household farms and are primarily marketed in small amounts at small retail outlets and bazaars. Because cucumbers are a very perishable product, they are rarely transported and exported to distant places. Because of this situation and under current circumstances, the possibility of cucumber exports to distant places such as Kazakhstan is not considered feasible at this time.

Greenhouse Vegetables

Most of the agriculture in the Ferghana Valley is in fact subsistence farming. Although most farming enterprises are inherently risky, farmers through trial

and error have adjusted to a diversity of circumstances to reduce risks and maximize benefits. In general, farmers are mostly viewed as risk averse. However, regarding greenhouse farming, the attitudes and perceptions of farmers and the challenges they confront are quite different. First of all, greenhouse farming requires substantial entrepreneurial skills and technical and managerial capacity by farmers; therefore, it is at the opposite extreme of subsistence agriculture in the path toward a modern and productive agriculture. Second, greenhouse farm enterprises require considerable initial investment and financial resources that are not usually available to farmers or entrepreneurs interested in this kind of business. The intensity of crop management activities associated with greenhouse farming is quite different from the "open-field" cultivation of vegetable crops and requires special managerial skills, hard work, and expertise from the farmer.

Greenhouse construction costs in southern Kyrgyzstan range from $10 to $20/m^2 of ground space, whereas operating costs vary substantially depending on the weather and the need for the operation of heating systems. Therefore, production costs are significantly higher for greenhouse vegetables than for open-field crops. For example, in the case of tomato production, the average cost of tomatoes produced in open-field farms is about 0.51 Soms/kg while tomatoes produced on greenhouse farms cost about 17 times more, that is, 8.51 Soms/kg.

Estimates of private and social profitability and DRC ratios for greenhouse vegetable crops are presented in Table 4.3. These estimates are calculated per 0.1 ha and show very high private and social profits for tomatoes and cucumbers. The high levels of profits and very low DRC ratios for tomatoes and cucumbers under import parity (0.18 and 0.17 for tomatoes and cucumbers, respectively) and at non-traded parity prices (0.17 for both crops) imply that greenhouse production of tomatoes and cucumbers is economically justified if assumptions made regarding costs and prices hold and are sustainable. Despite the very positive estimates obtained on the profitability of these enterprises, southern Kyrgyzstan is not necessarily in a favorable position to produce greenhouse tomatoes and cucumbers for import substitution. As Figure 4.1 shows,

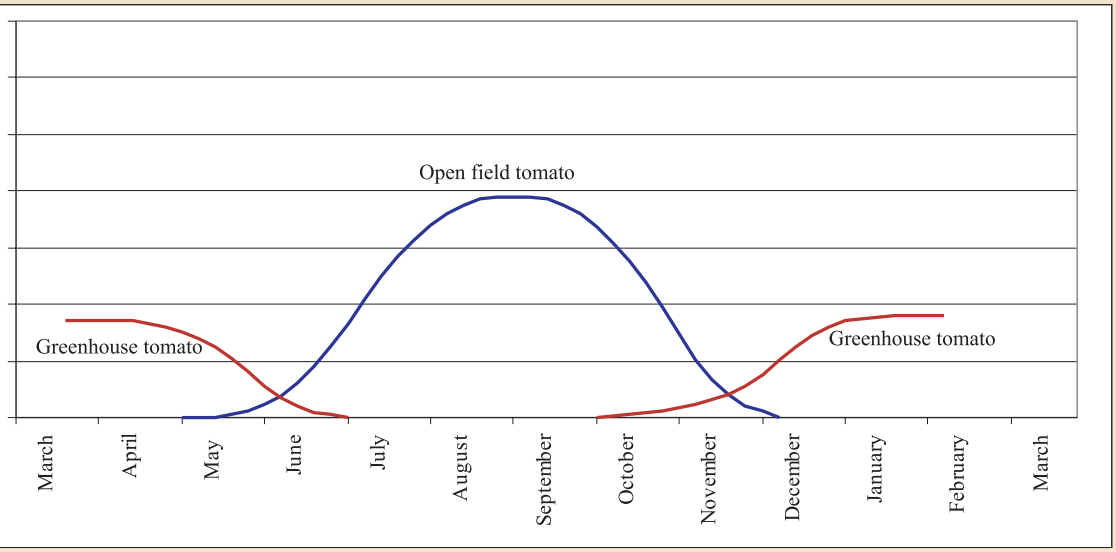

Figure 4.1. Seasonality of Open-Field and Greenhouse Tomato Production

there is seasonality in the role of the two main sources of supply of tomatoes. There are periods when either open-field or greenhouse production is the dominant supplier but also there are periods when both open-field and greenhouse tomatoes appear in the market at the same time. Tomatoes from these two sources can vary substantially in quality and prices; usually greenhouse tomatoes are much better in quality, but their prices are six times as high as those of open-field tomatoes.

Unlike tomatoes and cucumbers, estimates on the production of greenhouse watermelons show very modest private and social profits. Moreover, in assessing the feasibility of greenhouse production of watermelons, it is important to consider that because watermelons can be stored for several months the possibilities for a seasonal demand for greenhouse watermelons are seriously reduced. Also, because greenhouse watermelon production is not well developed, the estimates presented here should be viewed only as rough approximations and should be treated with caution.

Factors of Endowment and Use

It may be useful to explore the role that the endowment and use of factors of production have in the context of comparative economic advantage analysis. This is an important issue to address because any policy implementation directly or indirectly affects the employment of land, capital, and labor. As indicated previously, although technical progress may cause some distortions, each nation usually gains from the intensive use of their domestically abundant factors of production.

General budgets of average-scale farms calculated at social prices for main, vegetable, and greenhouse crop enterprises are presented in Tables 4.4-4.6.

Table 4.4. Budgets of Main Crop Enterprises on Average-Scale Farms Calculated at Social Prices. Based on 1999-2002 Average Output Prices and Non-Traded Parity Prices

Crop Enterprises	Farm-Gate Parity Price	DRC	Social Profit	Total Costs	Variable Costs	Labor	Labor Costs	Machinery Service Costs	Labor Costs
	(Soms)		(Soms/ha)			(hours/ha)	(Soms/ha)		(%)
Wheat	4.59	0.63	4,666	13,694	13,694	92	1,912	3,088	14.0
Cotton	13.70	0.47	16,507	24,593	24,593	940	8,509	5,329	34.6
Rice	19.10	0.35	33,664	23,636	23,636	846	6,464	1,377	27.4
Maize	4.18	0.45	10,927	14,153	14,153	208	2,967	3,374	21.0
Sunflowers	9.06	0.48	10,723	11,927	11,927	405	3,106	1,077	26.0
Barley	3.33	1.14	-950	14,270	14,270	95	2,086	3,637	14.6

Table 4.5. Budgets of Vegetable Crop Enterprises on Average-Scale Farms Calculated at Social Prices. Based on 1999-2002 Average Output Prices and Non-Traded Parity Prices

Items	Farm-Gate Parity Price	DRC	Social Profit	Total Costs	Variable Costs	Labor	Labor Costs	Machinery Service Costs	Labor Costs
						(hour)			(%)
Potatoes	3.47	0.36	39,701	47,049	47,049	1,268	11,755	5,049	25.0
Tomatoes	1.51	0.24	51,671	23,829	23,829	1,360	10,301	2,548	43.2
Onions	2.12	0.34	55,845	39,555	39,555	2,458	17,779	1,934	44.9
Watermelons	1.34	0.22	59,808	20,592	20,592	1,535	11,066	1,067	53.7
Cucumbers	1.77	0.29	48,236	22,564	22,564	1,885	13,516	1,067	59.9

Table 4.6. Budgets of Greenhouse Crop Enterprises Calculated at Social Prices. Estimates Based on 1999-2002 Average Output Prices and Non-Traded Parity Prices

Items	Farm-Gate Parity Price	DRC	Social Profit	Total Costs	Variable Costs	Labor	Labor Costs	Machinery Service Costs	Labor Costs
			(Soms/ha)			(hours)	(Soms/ha)		(%)
Tomatoes	39.72	0.15	323,167	74,033	62,533	169	1,207	117	1.63
Cucumbers	37.20	0.15	332,967	94,833	83,333	179	1,277	117	1.35
Watermelons	12.37	0.79	6,969	36,141	24,641	124	892	117	2.47

These budget estimates show that total costs are equal to variable costs for all crops except greenhouse vegetables. Total costs of production of vegetable crops are considerably higher than those of main crops. Wheat and barley are the least labor intensive among the selected crops mainly because machinery is used for crop management practices and harvesting tasks. Estimates of profits and DRC ratios show that both crops (wheat and barley) make poor use of Kyrgyzstan's domestic resource.

These budgets also show that (1) fewer machinery services are required for sunflower production because usually only labor is used to harvest the crop; (2) production costs of cotton and rice are almost the same and are the highest among main crops, but profits from rice are twice as high as those from cotton; (3) cotton production is the most labor-intensive enterprise, but unlike rice most of the labor is needed during harvesting, thus cotton production is an excellent source of seasonal employment for casual labor; and (4) sunflowers and maize have similar social profits and DRC ratios but less machinery and more labor is employed in sunflower production.

As shown in Table 4.5, vegetables are relatively labor-intensive crops to grow, and their total costs of production are much greater than those of the main crops. These estimates also indicate that (1) potatoes are the most-expensive crop to grow—if proper potato seeds are used, only the cost of potato seed can often exceed the total cost of production of wheat or maize—a total cost of 47,049 Soms (about $1,022)/ha is a large amount for Kyrgyz farmers to afford; (2) a large quantity of labor is employed in potato production, and primarily labor (rather than machinery) is used in potato harvesting; and (3) although potato production shows relatively less comparative advantage than other vegetable crops, the benefit that potatoes provide in terms of facility for storage and marketing more than compensate for the modest indicators of comparative advantage. Small-scale farmers have managed to continue with potato production year after year by using low-quality potatoes for seeding purposes.

Tomato and watermelon production enterprises show some of the lowest production cost estimates and highest profits. However, the demand for these crops is quite elastic, and prices are unstable and subject to drastic fluctuations. Watermelon and cucumber production are the most labor-intensive enterprises. In these crops labor cost accounts for about one-half of the total cost of production. The production of onions is also a labor-intensive enterprise accounting for about 45% of the total cost of production.

Greenhouse farming may be viewed as a way to overcome comparative disadvantages through capital investment and technology (Table 4.6), whereas agro-climatic conditions and natural resources are important factors affecting open field crop production. In greenhouse farming the lack of proper agro-climatic conditions is essentially overcome through investments in facilities and technology. Domestic resources of land and labor account for a very small part of the total production costs of greenhouse farm enterprises. The total cost of production of a 0.1 ha

of greenhouse vegetables significantly exceeds the cost of production of 1 ha of open-field vegetables. By considering the region's infrastructure and other circumstances, electric power is treated here as a domestic factor even though there may be a good basis to treat electrical energy in Central Asia as a tradable commodity. If this were the case, then large variation and fluctuations in the comparative advantage of greenhouse vegetable production among countries should not exist. In the short-run, most of the apparent differences in production costs would be explained by differences in weather affecting energy consumption and also by some differences in energy sources and labor opportunity costs. In the long run, however, significant differences in comparative advantage of greenhouse crop production could emerge as a result of accumulative improvements in technology and in the knowledge, skills, and experience of the human resource base involved in these enterprises. Estimates of large profits for the greenhouse crop enterprises shown in Table 4.6 are based on the assumption that there is a good demand and market for these vegetables in southern Kyrgyzstan during the winter season. The economic feasibility and profitability of these enterprises depend fundamentally on the existence of such a market.

It is apparent from the results obtained for the production of main crops and vegetable crop enterprises that the comparative advantages of these enterprises are functionally related to their labor intensities. That relationship is graphically presented in Figure 4.2 and is based in the ordinary least square estimates of a regression model where the dependent variable is the comparative advantage indicator DRC, and the independent variable is the logarithm of labor costs relative to total costs that are included to measure labor intensity. Parameter estimates of this model are presented in Table 4.7 and show that as labor intensity increases DRC ratios decline, and the marginal product of labor declines as more labor is used. In this case, it approaches zero as labor costs as a percentage of total costs approach 50.

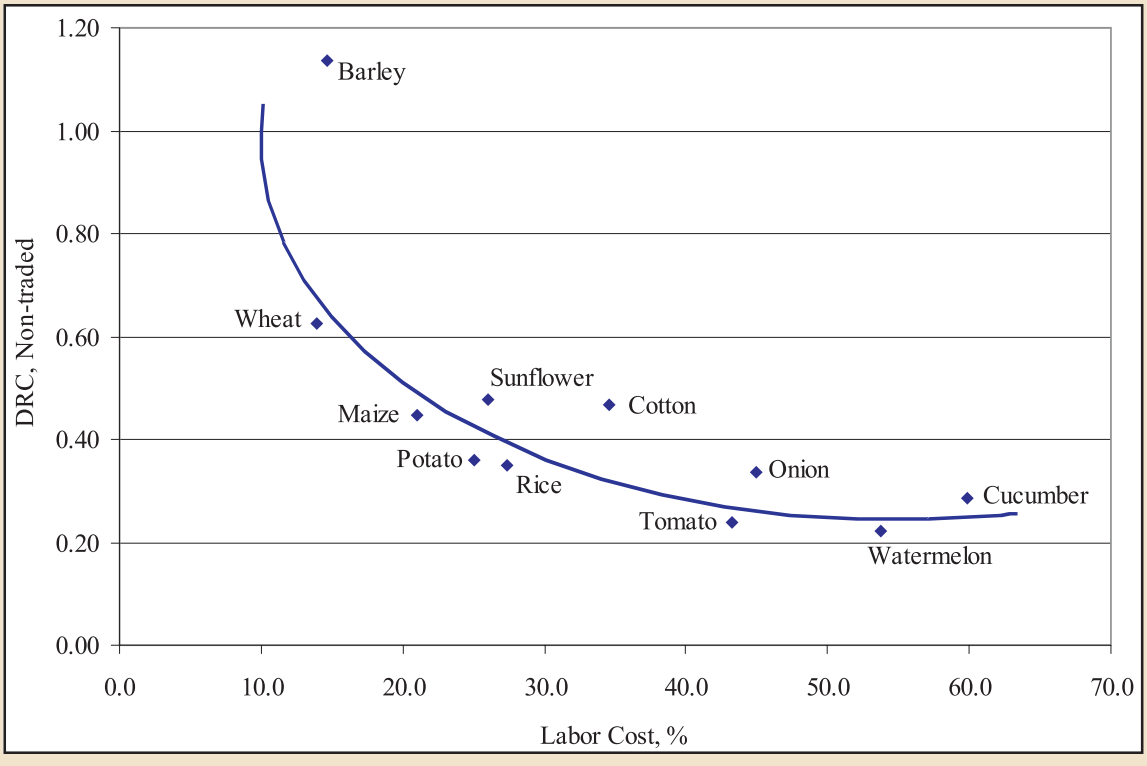

Figure 4.2. Functional Relationship Between DRC Ratios and Intensity of Labor Use in Selected Crop Production Enterprises

Table 4.7. Parameter Estimates of Model Regressing DRC Ratios on Labor Intensity

Dependent variable: DRC

Variable	Coefficient	Standard Error	t-statistic	Level of Significance
Constant	1.803819	0.383452	4.70	0.001
Ln(Labor,%)	-0.398698	0.112004	-3.56	0.006

$R^2 = 0.60$ Adjusted $R^2 = 0.54$

Southern Kyrgyzstan as a labor-abundant region is expected to have comparative advantages for the production of labor-intensive products. Indeed, Figure 4.2 and estimates of the regression model shown in Table 4.7 confirm this expectation. Crop production enterprises that are more labor intensive have better comparative advantages.

Economies of Scale

In an attempt to identify and evaluate economies of scale, estimates of DRC ratios for different farm sizes were calculated. Estimates of DRC ratios as indicators of comparative advantages of crop enterprises at different scales of farming operations are presented in Table 4.8. These estimates show that DRC ratios of all crop enterprises were smaller in small-scale household farms than in average- and large-scale farms. Thus, it would appear that these results show no evidence of economies of scale in the production of these crops. However, these results should be treated with great caution because the observed differences in DRC ratios are, in fact, determined by factors and circumstances that are not directly related to the scale of operation. For instance, the large differences in DRC ratios for vegetable crops between household and average-scale farms are mainly due to the labor use intensity

Table 4.8. Estimates of DRC Ratios as Indicators of Comparative Advantages of Crop Enterprises at Different Scales of Farming Operations

Crop Enterprises	DRC Ratios			Ranking by DRC Ratios			Difference in DRC Ratios: Average Versus Small
	Small-Scale Household Farms	Average-Scale Farms	Large-Scale farms	Small- Scale Household Farms	Average-Scale Farms	Large-Scale Farms	
Main crops							
Wheat	0.60	0.63	0.65	1	2	3	0.03
Cotton	-	0.47	0.45	-	2	1	-
Rice	-	0.35	-	-	-	-	-
Maize	0.41	0.45	0.45	1	2	3	0.04
Sunflowers	0.40	0.48	0.54	1	2	3	0.08
Barley	-	1.14	1.15	-	1	2	-
Vegetable crops							
Potatoes	0.28	0.36	-	1	2	-	0.12
Tomatoes	0.16	0.24	-	1	2	-	0.08
Onions	0.22	0.34	-	1	2	-	0.12
Watermelons	0.14	0.22	-	1	2	-	0.08
Cucumbers	0.18	0.29	-	1	2	-	0.11

of these crops and the manner in which family labor is priced in the small-scale household farms. In these estimates, the very low social price given to labor used by small-scale household farms is a key determinant of the comparative advantage of these farms. Therefore, results presented in Table 4.8 are for most crops not good measures of economies (or diseconomies) of scale.

With the exception of cotton (where machinery is more intensively employed by large farms), the other main crops on large-scale farms do not show greater efficiency than smaller scale farms. Economies of scale in agriculture are usually associated with mechanization and the increased efficiency in the use of machinery and equipment that results in increased returns to land and labor as the scale of operation increases. In southern Kyrgyzstan, however, unemployment and low relative labor/capital prices seriously limit the possibilities for mechanization in agriculture.

Returns to Improvements in Skills

The PAM approach allows the analysis of comparative advantages at a given point in time. However, comparative advantages do change in response to changes in economic circumstances, the quality of resources and, in particular, to changes in the knowledge and skills of the human resource base. Improvements in technology and human capital are important components of policies and efforts to improve and strengthen the comparative advantages and competitiveness of production enterprises in a region or country. Although the contributions of these components to Kyrgyzstan's agricultural development are difficult to measure, it should be recognized that they are essential and should not be ignored.

The argument that factors of comparative advantage are not only inherited but can also be created within the nation is illustrated by an analysis of crop yield changes in recent years shown in Figure 4.3. As recent research indicates, the poor crop yields of 1993-95 can be explained in part by the sudden shift of labor and jobs to the agricultural sector. Despite the decline in soil fertility due to nutrient mining in the past decades, the yields of most agricultural crops in the country have been increasing up to the crop yield levels that existed before independence. How-

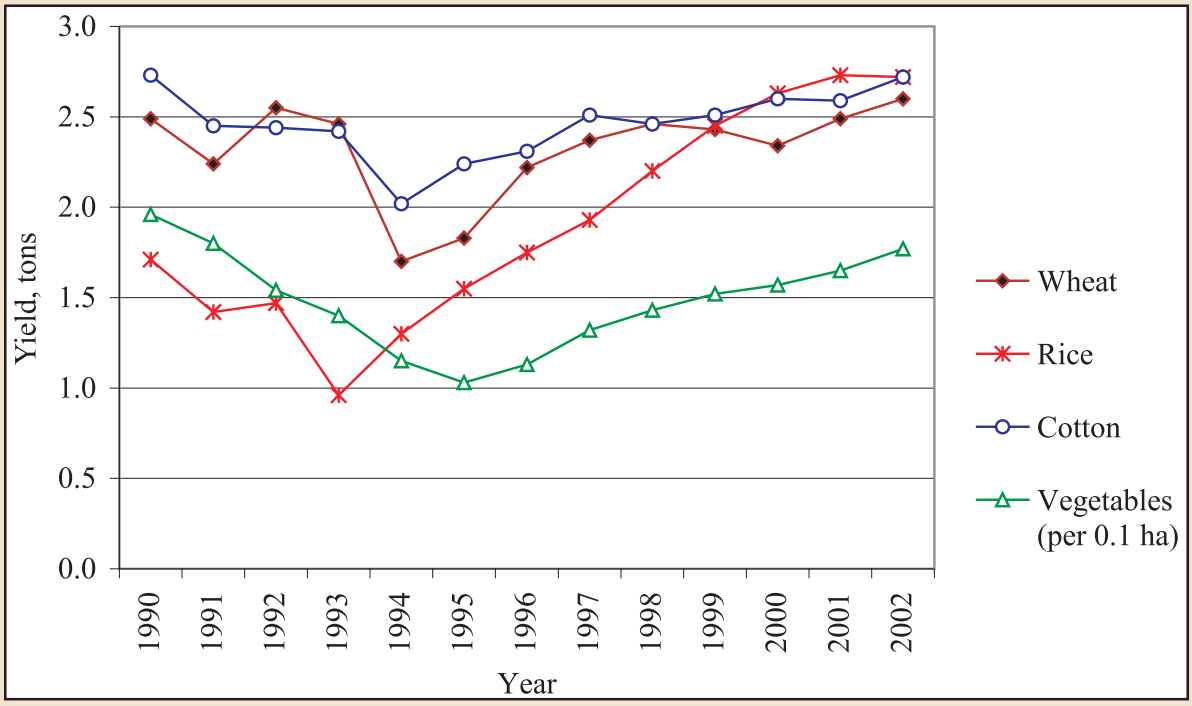

Figure 4.3. Time Series Data of Yields of Selected Crops in Kyrgyzstan

ever, there is still a great potential for improvement in the productivity of agriculture in Kyrgyzstan through investments in improved technology and human capital.

It is worthwhile to mention and discuss the changes in rice production in recent years as an example of the results of improvement in technology and human capital over the past decade. As shown in Figure 4.3, rice yields increased by 91% between 1990 and 2000. A sharp and rapid increase in rice yields began in 1993 and continued for almost a decade. The data show significant increases and differences in rice yields across different regions. In Aravan and Uzgen regions, rice yields were 3.85 and 2.70 tons/ha, respectively, in 2002, whereas in the Karakulga and Kara-Suu regions, rice yields were 1.90 and 1.62 tons/ha, respectively.

The large differences in rice yields among regions are due mainly to variations in crop management and technology rather than as a result of differences in climatic conditions. Indeed, if this PAM study had been conducted several years ago, rice production would have been the crop production enterprise with the least comparative advantage among the selected main crops (Table 4.9). Modern management practices require planting rice seedlings whereas in traditional technology rice is just sowed. Consequently, modern technology requires fewer rice seeds but use more labor during planting. Weeding expenses are also reduced due to planting. In general, rice yields are increased from 1.9 up to 3.0 tons/ha by using modern planting technology although production costs are reduced by 9%.

As is happening with rice, the production technology of other crops can also be improved and the comparative advantage of those crops strengthened. The potential for yield increases of various crops in Kyrgyzstan requires further detailed analysis and should be studied separately. A project conducted

Table 4.9. Rice Production Using Different Technology

Items	Unit	Sowing Technology (traditional)	Planting Technology (modern)	Difference
Seed	kg	250	40	-210
Seed	Soms	5,000	800	-4,200
Fertilizer	Soms	2,390	3,824	1,434
CPP	Soms	0	0	0
Machinery services	Soms	1,382	1,382	0
Labor				0
Sowing	Soms	875	0	-875
Planting	Soms	0	2,100	2,100
Weeding	Soms	2,800	1,400	-1,400
Harvest	Soms	980	980	0
Water management	Soms	1,400	1,400	0
Land	Soms	9,000	9,000	0
Water	Soms	1,000	1,000	0
Processing	Soms	1,250	1,750	500
Yield	kg	1,900	3,000	1,100
Rice price	Soms	19.10	19.10	0
Revenue	Soms	36,290	57,300	21,010
Total costs	Soms	26,077	23,636	-2,441
Net profit	Soms	10,213	33,664	23,451
DRC ratio		0.64	0.35	-
DRC rank		6th of 6	1st of 6	-

by IFDC in southern Kyrgyzstan is assisting in the development of technology transfer centers that have been researching crop seed varieties and different management practices to identify technologies that can be adopted by farmers to increase crop yields and improve economic efficiency.

The reader reviewing this part of the paper may be wondering if it was really necessary to estimate the comparative advantages of crops if these were to change so much in response to changes in technology and management. In this regard, it is important to mention that Kyrgyzstan is a country that is still going through a metamorphosis of transformations and adjustments where the information provided by this study is extremely useful to make better decisions on policy design and implementation to promote economic development and growth. This type of information is particularly more important in developing countries that are experiencing rapid transformation and adjustments. To make better decisions, policymakers and business entrepreneurs should use this information in conjunction with other economic information that provides a good estimate of the expectations concerning changes in the dynamic factors and circumstances that affect the comparative advantage and competitiveness of crop production enterprises in Kyrgyzstan. However, it is important to recognize that even with the best information, there are always risks and uncertainty in decision-making.

V. Sensitivity Analysis

In the previous chapter, estimates of private and social profitability and indicators of comparative advantage (DRC ratios) for selected farm-crop enterprises are presented and discussed. These estimates, however, are snapshots reflecting the static circumstances represented by the data used in the analysis. Although the indicators of comparative advantage are calculated at a given point in time and for a given set of circumstances, comparative advantages do change in response to changes in resource endowments, prices, and production technology. It is therefore useful to assess the robustness or sensitivity of the results that are estimated to the changes in circumstances that are likely to occur in the market and policy environments.

Sensitivity of Social Profitability to Changes in Prices of Inputs and Outputs

First of all, it is useful to assess the sensitivity of profitability indicators to changes in prices of inputs. For this purpose, it is helpful to analyze first the cost structure of crop production to determine the relative importance of various inputs, factors, and cost components on total cost of production because changes in prices of inputs or factors that are more intensively used (relatively more important) should have a greater impact on profits. The cost structure and social profit for main crops is graphically illustrated in Figure 5.1, in which the main cost components and profits are measured as a percentage of total cost (100%). Land costs vary from 22% to 40% of total cost of production of main crops. Therefore, changes in land price may have quite a significant impact on the profitability of these crops. Machinery costs account for 23%-26% of total costs for barley, maize, cotton, and wheat. More labor and less mechanical power (machinery) are employed in rice and sunflower production. The profitability of cotton production also appears to be sensitive to changes in the price of labor (wage rate). Although water does not account for a large portion of total costs, arable land that is closed to sources of water is considerably more costly than similar land with limited access to water. Variable inputs such as seed, fertilizer, and CPPs account for 20%-30% of total costs of all main crops except for sunflowers. However, an increase in inputs prices may reduce their use, which, in turn, would have a much greater impact on crop yields and their profitability. Rice and sunflowers show high levels of profitability and are, therefore, less sensitive in relative terms to increases in input and other variable costs than

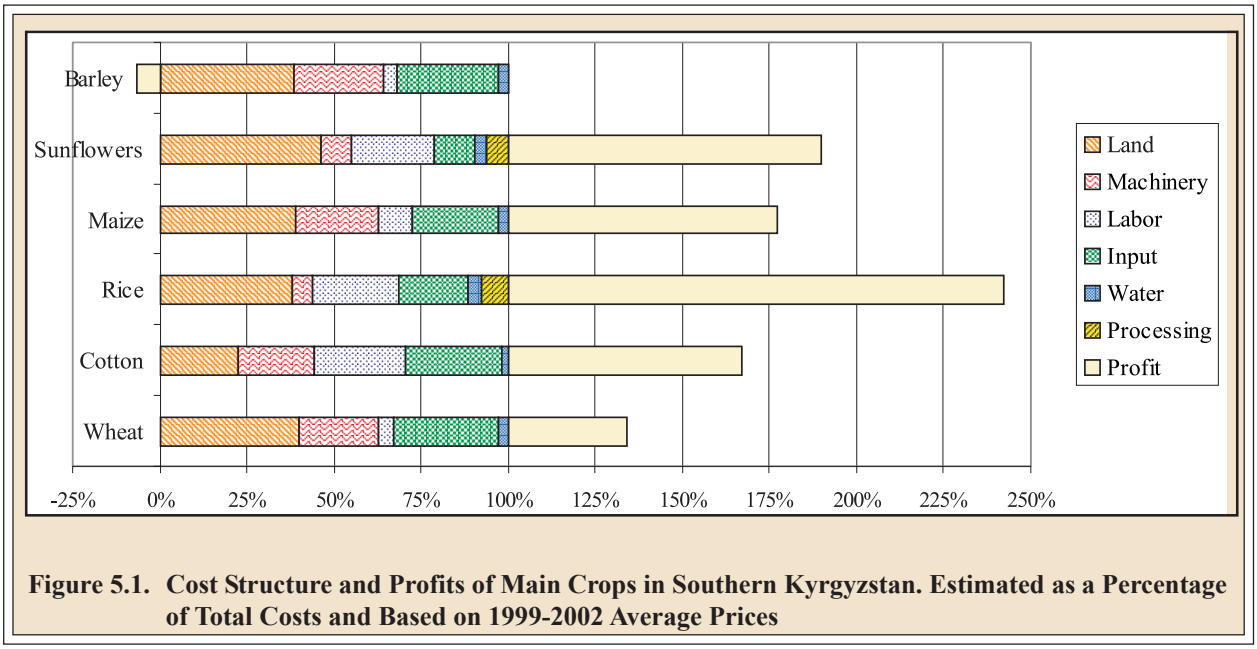

Figure 5.1. Cost Structure and Profits of Main Crops in Southern Kyrgyzstan. Estimated as a Percentage of Total Costs and Based on 1999-2002 Average Prices

wheat production showing a lower level of profitability. In contrast with the results on main crops discussed above, the profitability of vegetable production is more sensitive to changes in labor costs than to changes in land prices (Figure 5.2). Potatoes are more sensitive to input price changes, especially seed. Changes in machinery costs should not have an impact on profits greater than the impact of changes in the cost of inputs. With the exception of potatoes, other vegetables shown in Figure 5.2 have high levels of profitability and are therefore less sensitive to changes in total costs.

Greenhouse tomatoes and cucumbers have very high profitability estimates that are not very sensitive to changes in total costs. Cost of the energy required for greenhouse heating accounts for the largest portion of total costs. The price of electricity is currently the most important determinant of the profitability of the production of greenhouse vegetables. However, alternative sources of energy such as coal and biogas could be sought. The cost of inputs such as high quality seeds, plastic sheets, and other implements and the depreciation of the greenhouse are the other two major components of the cost of production of greenhouse vegetables. As a result of the capital intensity associated with greenhouse production, factors of production such as water, labor, and land account for a very small portion of total costs (Figure 5.3).

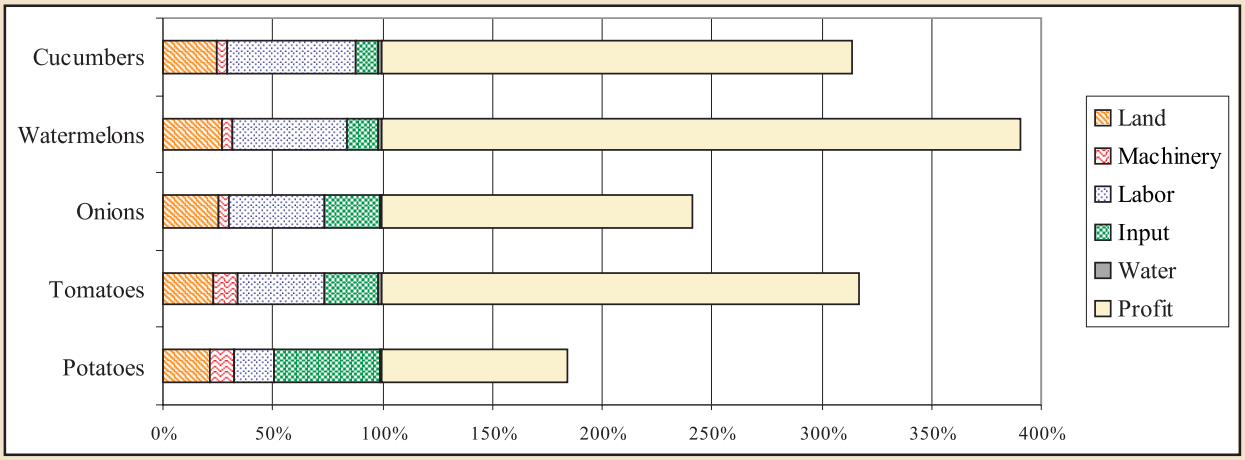

Figure 5.2. Cost Structure and Profits of Vegetable Crops in Southern Kyrgyzstan. Estimated as a Percentage of Total Costs and Based on 1999-2002 Average Prices

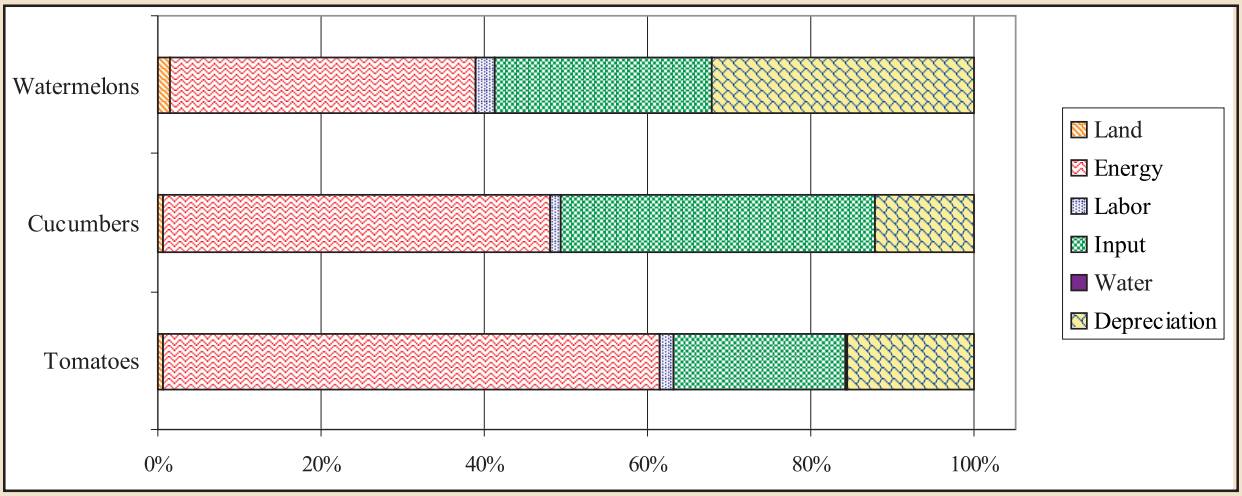

Figure 5.3. Cost Structure of Greenhouse Vegetable Crops in Southern Kyrgyzstan. Estimated as a Percentage of Total Costs and Based on 1999-2002 Average Prices

Estimates of expected changes in economic (social) profitability in response to changes in output price or yield and costs of land, machinery, labor and variable inputs are calculated to assess the sensitivity of profits to changes in price and cost variables. Estimates measuring the expected percentage of change in profits associated with a 1% change in the price and cost variables are presented in Table 5.1. Among other results, these estimates show that (1) a 1% increase in wheat price (or yield) would increase profits of wheat production by 3.94%; and (2) in cotton production a decrease of input prices by 1% is expected to cause a 0.42% increase in profit. These estimates also show that changes in output prices (or yields) are very important to farmers because relatively small changes in output prices (or yield) can significantly impact crop profitability—all estimates in the price/yield column of Table 5.1 are greater than 1. As a result of smaller "initial" levels of profitability, the response of profits of main crops to changes in crop prices on a percentage basis (Table 5.1) are in general larger than those of vegetable crops. In relative terms, barley, wheat, and cotton profits are more sensitive to price changes than the profits of other crops. Profits of rice and vegetable crops other than potatoes show less responsiveness to changes in output prices (or yields). Regarding the effects of cost changes on profitability, the profits of the main crops are relatively more sensitive to changes in land prices whereas the profits of the vegetable crops are relatively more sensitive to changes in labor costs.

Sensitivity of Social Profitability to Output Price Fluctuations

In the previous section we evaluated the sensitivity of profitability of crop production to changes in prices of crop output. The sensitivity of profits to output price changes and the volatility of output prices are both very important to farmers. These two factors significantly affect the degree of profit uncertainty that is associated with a crop production enterprise. The volatility of crop output prices varies from one crop to another, depending on market circumstances and the nature of the demand and supply of each product. To assess the degree of uncertainty about profits in the crop production enterprises, 1999-2002 price data were used to estimate lower and upper bound estimates of price fluctuations and their associated effects on the indicators of private profitability and DRC ratios of the crop production enterprises under evaluation. In Table 5.2, these estimates calculated on the basis of non-traded farm-gate parity prices are presented for the crop production enterprises on average-scale farms. To measure the possible impact of price fluctuations on the private and social profitability of crop

Table 5.1. Estimates of Expected Percentage Change in Profits Associated With a 1% Change in Output Price (or Yield) and Cost Variables

Crops	Output Price (or yield)	Land	Machinery	Labor	Input	Water
Main crops						
Wheat	3.94	-1.18	-0.67	-0.13	-0.88	-0.09
Cotton	2.49	-0.33	-0.32	-0.39	-0.42	-0.02
Rice	1.70	-0.27	-0.04	-0.17	-0.14	-0.03
Maize	2.30	-0.50	-0.31	-0.13	-0.32	-0.04
Sunflowers	2.11	-0.51	-0.10	-0.26	-0.13	-0.04
Barley	14.02	-5.79	-3.85	-0.63	-4.34	-0.42
Vegetables						
Potatoes	2.19	-0.25	-0.13	-0.22	-.58	-0.01
Tomatoes	1.46	-0.11	-0.05	-0.18	-0.11	-0.01
Onions	1.71	-0.18	-0.03	-0.31	-0.18	-0.01
Watermelons	1.34	-0.09	-0.02	-0.18	-0.05	-0.01
Cucumbers	1.47	-0.11	-0.02	-0.27	-0.05	-0.01

Table 5.2. Lower- and Upper-Bound Estimates of 1999-2002 Price Fluctuations and the Associated Effects on Indicators of Private Profitability and DRC Ratios of Crop Enterprises on Average-Scale Farms. Calculated on Basis of Non-Traded Farm-Gate Parity Prices

Crop Enterprises	% Price Changes		Private Profit		Economic Profit		Private Cost Ratios (PCR)		DRC Ratios		Profitability Protection	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
	(%)		(Soms/ha)									
Main Crops												
Wheat	-24%	22%	-918	7,442	306	8,666	1.13	0.51	0.96	0.47	-	0.86
Cotton	-19%	21%	6,244	22,834	8,677	25,267	0.70	0.39	0.62	0.36	0.72	0.90
Rice	-15%	15%	24,190	41,170	24,994	41,974	0.43	0.31	0.42	0.30	0.97	0.98
Maize	-22%	48%	4,248	21,708	5,407	22,867	0.68	0.29	0.62	0.28	0.79	0.95
Sunflowers	-17%	18%	6,424	14,399	6,898	14,873	0.60	0.40	0.59	0.40	0.93	0.97
Barley	-14%	9%	-4,359	-1,279	-2,830	250	2.20	1.19	1.55	0.97	0.65	-
Vegetable Crops												
Potatoes	-32%	28%	10,225	62,725	11,701	64,201	0.68	0.26	0.65	0.25	0.87	0.98
Tomatoes	-28%	41%	28,997	80,997	30,671	82,671	0.36	0.17	0.35	0.16	0.95	0.98
Onions	-56%	30%	1,292	82,742	2,745	84,195	0.96	0.25	0.91	0.25	0.47	0.98
Watermelons	-45%	90%	23,174	131,774	23,808	132,408	0.42	0.11	0.42	0.11	0.97	1.00
Cucumbers	-49%	42%	13,262	77,662	13,836	78,236	0.59	0.20	0.58	0.20	0.96	0.99
Greenhouse Crops												
Tomatoes	-15%	14%	253,960	366,860	264,967	377,867	0.21	0.16	0.18	0.13	0.96	0.97
Cucumbers	-11%	34%	275,524	466,424	286,392	477,292	0.20	0.13	0.17	0.11	0.96	0.98
Watermelons	-8%	8%	-1,251	6,039	3,249	10,539	1.04	0.83	0.89	0.72	-0.39	0.57

production, these results are based on price data that include the lowest and highest observed prices of each commodity during the 1999-2002 harvest seasons in southern Kyrgyzstan.

Lower bound deviations from the mean of output prices vary from –14% for rice to –24% for wheat. Rice appears to be a lower risk crop among the main crops; it shows a quite good comparative advantage indicator for the lowest observed price, the break-even price (Figure 5.4) is very low, 7.88 Soms/kg and has never been observed in southern Kyrgyzstan, and the small difference between PCR and DRC implies a very small effect of policy distortions on rice production for domestic consumption. However, at export parity prices (Table 5.3) rice production is significantly affected by policy interventions, mainly by value-added taxes imposed by Kazakhstan.

Barley is not profitable and has negative returns even with the highest observed price. The production of barley and wheat usually takes place on dry or marginal irrigated arable land. Wheat results show negative private profits at lower bound price levels. In recent years the price of wheat has been declining and getting closer to the break-even price level; there have been instances when the wheat price was below that level. Despite its low profitability, wheat production is expected to continue because it is very important for food security and for its socio-economic value.

The profitability of cotton production is significantly affected by policy interventions and market failures. The profitability protection indicator of cotton varies from 0.72 to 0.90, implying that private profit from cotton is substantially affected (decreased) by policy distortions. There is no evidence that the price of cotton has ever been below its break-even price of 8.2 Soms. Estimates of the profitability of sunflowers and maize are positive at all levels of observed prices.

Observed prices of vegetable products show considerably more variation than prices of main crop outputs. As a result of these price fluctuations, estimates of the private cost ratios (PCR) of potato production varied substantially from 0.26 to 0.68

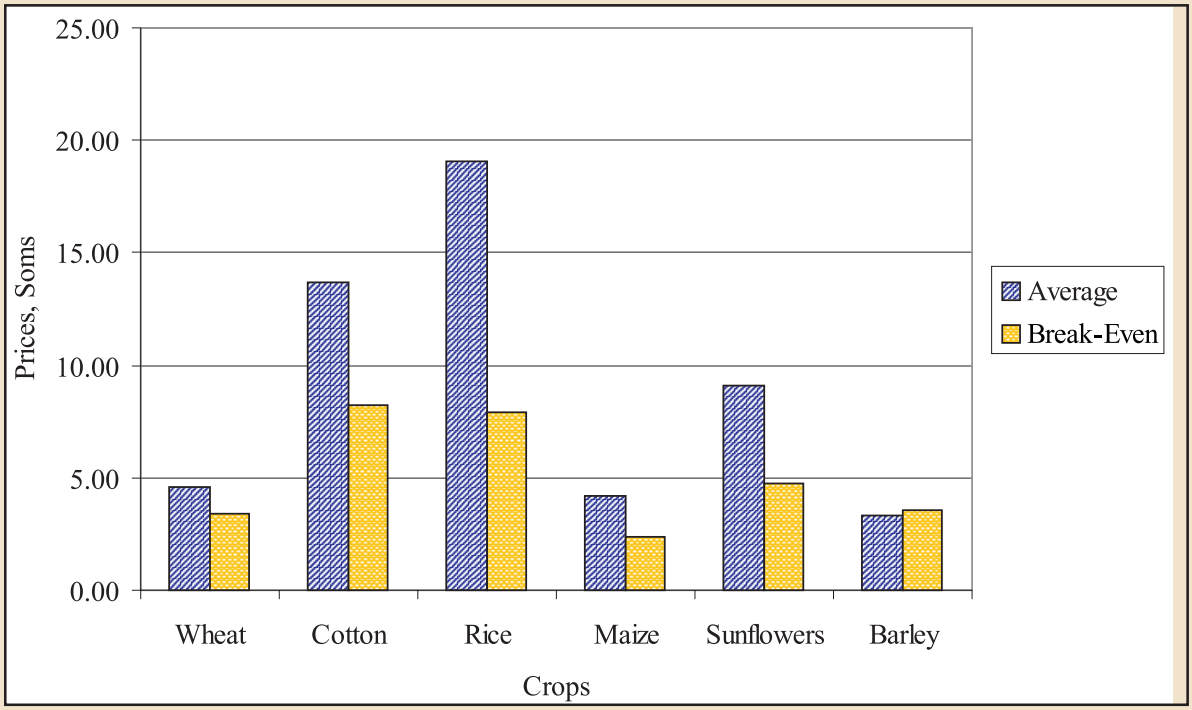

Figure 5.4. Average and Break-Even Prices for Main Crops on Average-Scale Farms. Calculated on a Non-Traded Farm-Gate Parity Basis

Table 5.3. Lower- and Upper-Bound Estimates of 1999-2002 Price Fluctuations and the Associated Effects on Indicators of Private Profitability and DRC Ratios of Crop Enterprises on Average-Scale Farms. Calculated on Basis of Export Parity Prices (Almaty, Kazakhstan)

Crop Enterprises	% Price Changes		Private Profit		Economic Profit		Private Cost Ratios (PCR)		DRC Ratios		Profitability Protection	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
	(%)		(Soms/ha)									
Cotton	-10	14	16,688	29,578	19,199	32,088	0.46	0.33	0.43	0.31	0.87	0.92
Rice	-9	7	12,310	20,020	19,959	28,899	0.60	0.48	0.48	0.39	0.62	0.69
Maize	-40	21	-11,316	4,164	-7,658	10,342	-3.66	0.68	-7.42	0.46	1.48	0.40
Potatoes	-20	49	-20,269	46,531	-6,334	71,266	-1.21	0.22	0.63	0.17	3.20	0.65
Tomatoes	-24	32	99,648	263,648	137,384	327,384	0.14	0.06	0.11	0.05	0.73	0.81
Onions	-39	43	785	186,185	24,354	239,454	0.97	0.13	0.54	0.11	0.03	0.78
Watermelons	-31	47	12,951	195,351	70,914	252,714	0.57	0.08	0.17	0.06	0.18	0.77

(Table 5.2). An analysis of potato production by small-scale household farmers shows that they are quite competitive in potato production having PCRs that vary from 0.09 to 0.22 due to the observed variation in prices. The high profitability of potato production in small-scale household farms is mostly due to the very low costs of land and labor. Estimates calculated at export parity prices for crops grown on average-scale farms are presented in Table 5.3. These estimates show that when prices are at the lower bound level, potato production is not profitable (PCR of 1.21) to substitute imports or promote exports unless current policy distortions are removed.

Estimates presented in Table 5.2 also show that although the break-even price of onions is much lower than the observed mean, large fluctuations in prices do happen and affect profits significantly. Profits of onion production vary from 1,292 to 82,742 Soms/ha at their lowest and highest prices, respectively. This large variability in profits implies that onion production is a risky enterprise. There have been instances when onion production lost profitability as a result of overproduction and increases in the price (rent) of land. At export parity prices (Table 5.3), the comparative advantage of onion production improves having a DRC ratio of 0.54 at the lowest observed price and a PCR of 0.97.

The profitability of tomato production is hardly affected by policy distortions, and profits are positive at all levels of observed price fluctuations. Also, at export parity prices, tomato production shows a high level of price (cost) competitiveness even at the lowest observed prices (PCR of 0.14). Considerable price fluctuations are observed for watermelon. The results shown in Tables 5.2 and 5.3 suggest that watermelon and cucumber are profitable at all levels of the observed 1999-2002 prices and that profits are hardly impacted by policy distortions. These results are consistent with estimates of average and break-even prices for vegetable crops on average-scale farms shown in Figure 5.5.

The production of greenhouse tomatoes and cucumbers maintains strong comparative advantages under all levels of observed price fluctuations. As is

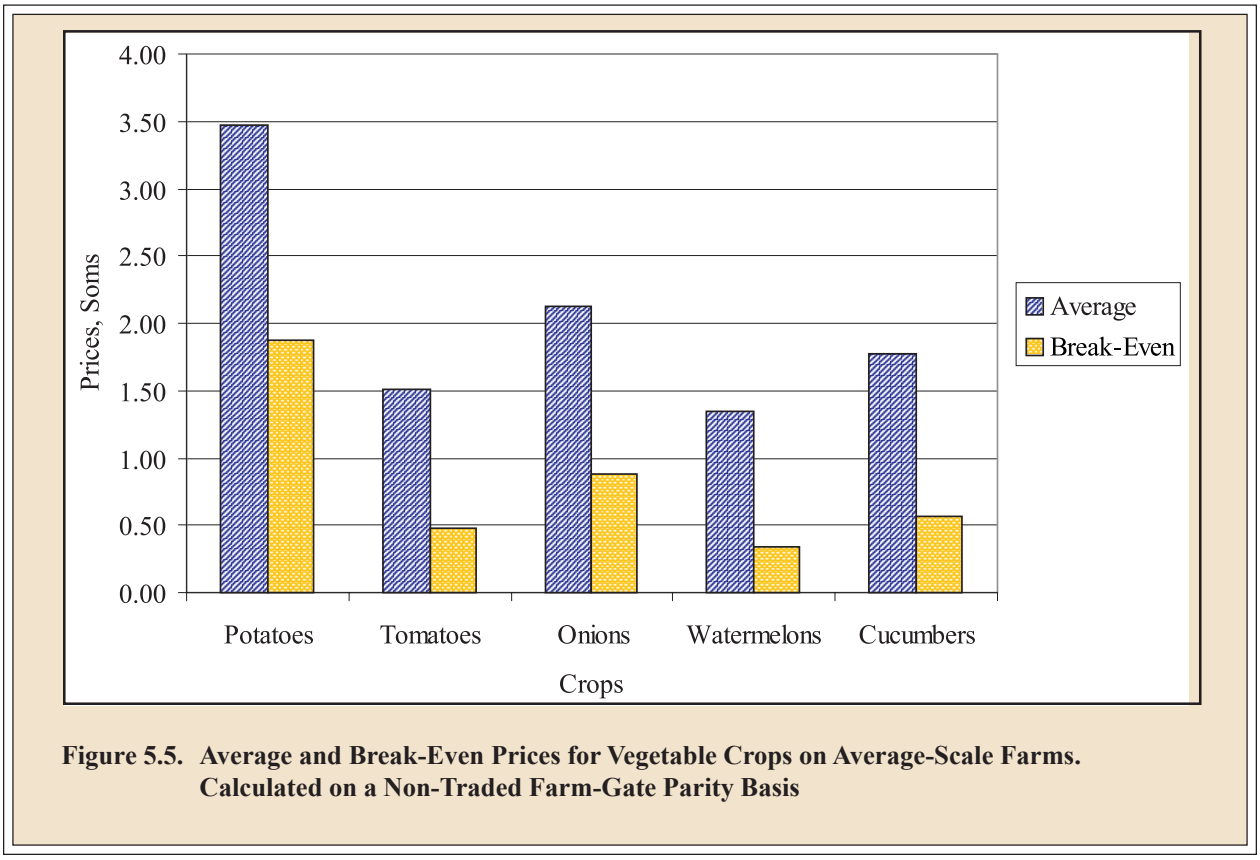

Figure 5.5. Average and Break-Even Prices for Vegetable Crops on Average-Scale Farms. Calculated on a Non-Traded Farm-Gate Parity Basis

shown in Figure 5.6, the break-even price estimates for tomatoes and cucumbers are 7.40 and 8.25 Soms/kg, respectively, and these low prices have not been observed in recent years. Greenhouse production of watermelons shows low profitability at average price levels, and profits are negative at the lowest observed price.

Figures 5.7 and 5.8 graphically illustrate the broad range of estimated DRC ratios of the crop enterprises under evaluation calculated on a non-traded basis for average-scale farms. These estimates show the variability of comparative advantage indicators that is associated with the observed 1999-2002 crop output price fluctuations. Results of estimates corresponding to crop enterprises in small-scale household farms are illustrated in Figure 5.9 and show the profitability of crop production in these farms at all levels of observed prices.

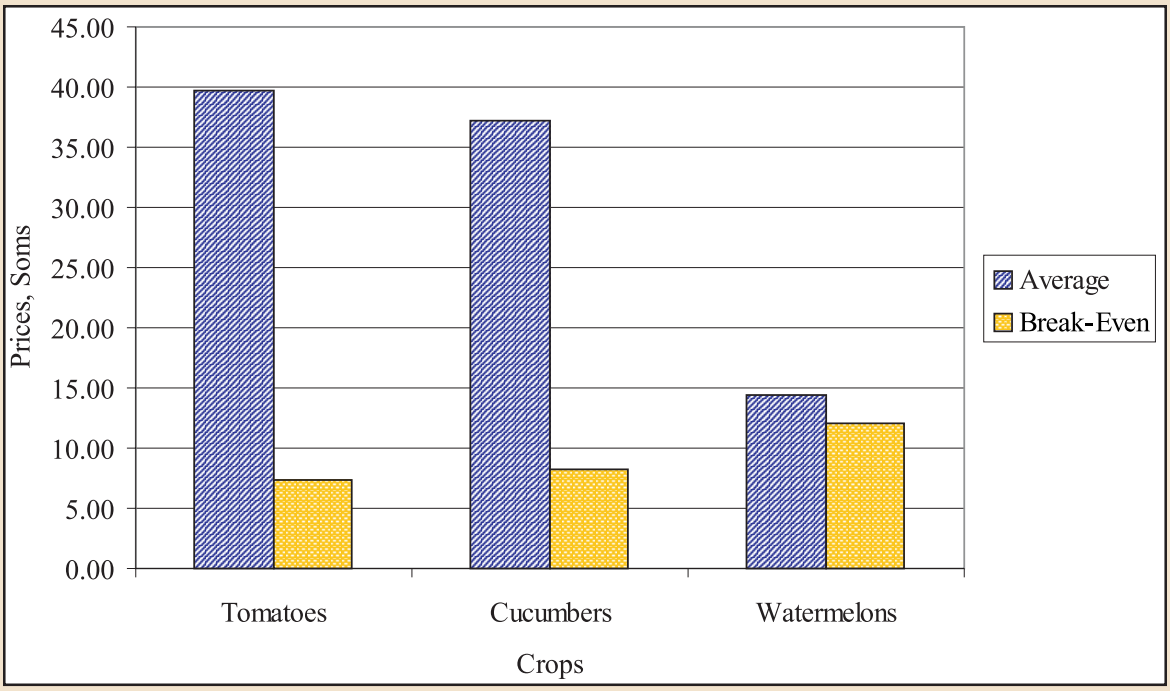

Figure 5.6. Average and Break-Even Prices for Greenhouse Vegetable Enterprises Calculated on a Non-Traded Farm-Gate Parity Basis

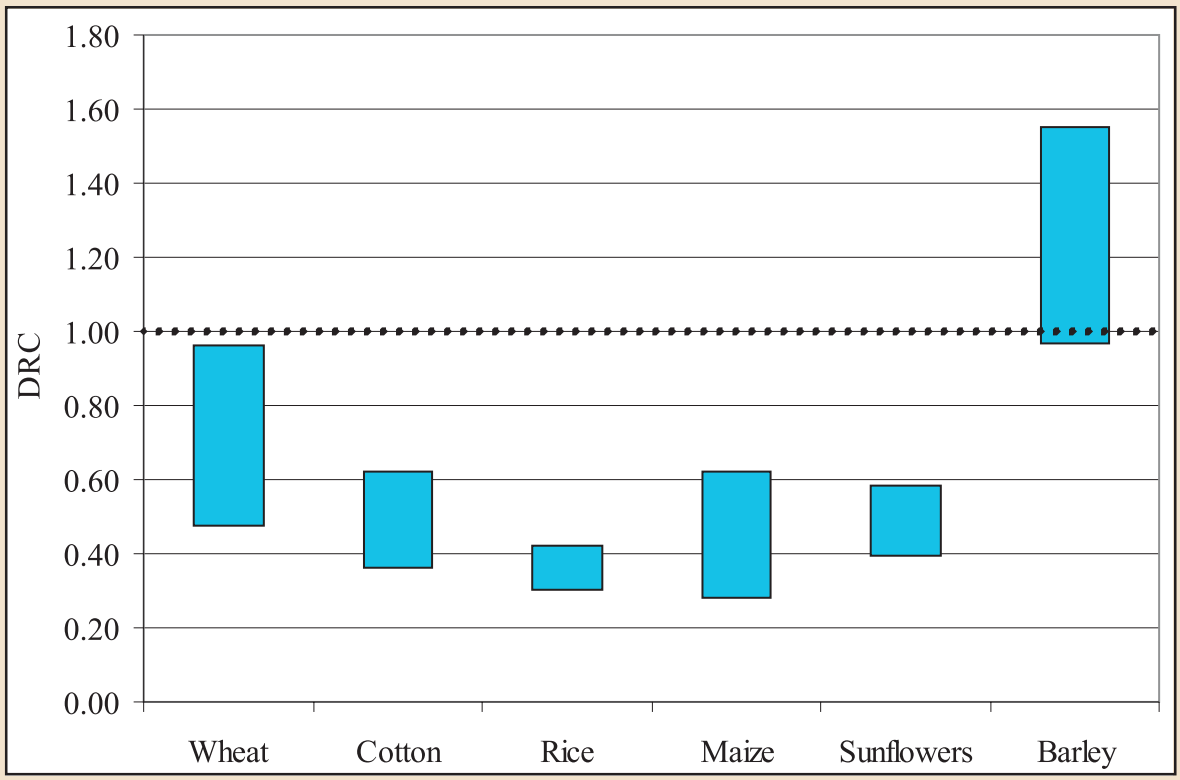

Figure 5.7. Variability of DRC Ratios of Main Crops on Average-Scale Farms Due to Price Fluctuations in 1999-2002. Calculated on a Non-Traded Farm-Gate Parity Basis

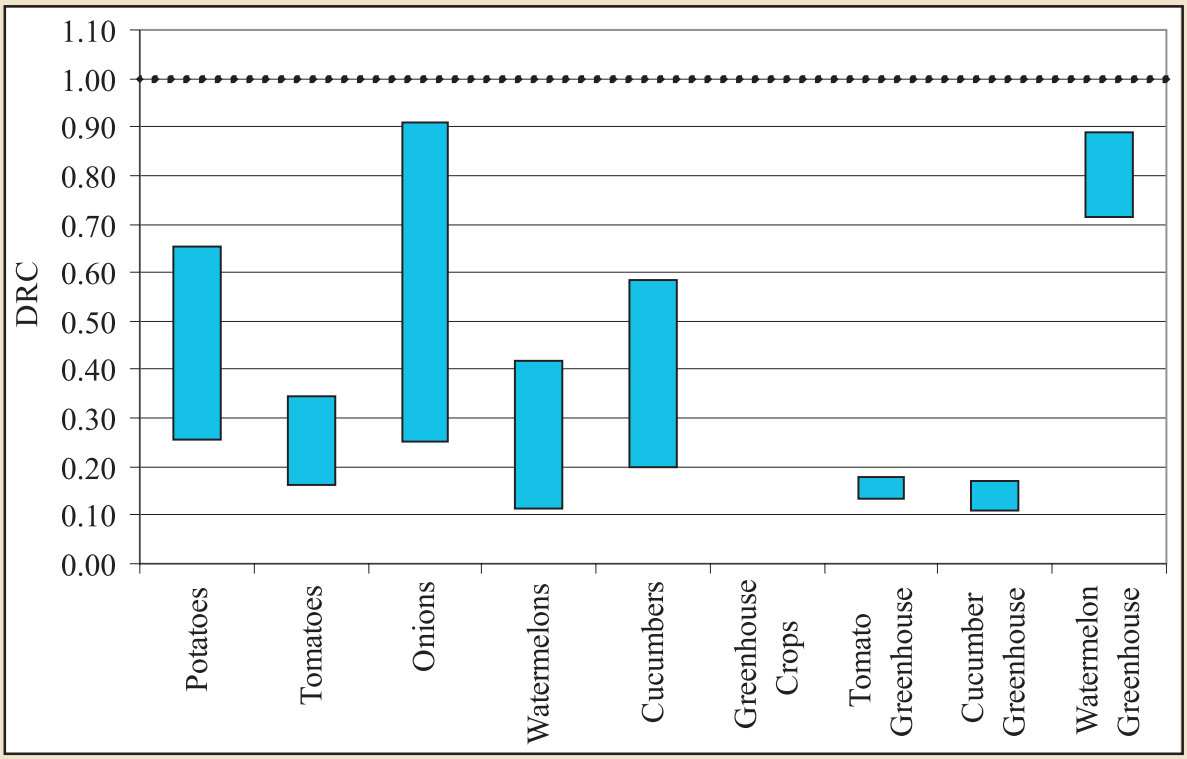

Figure 5.8. Variability of DRC Ratios of Vegetable Crops on Average-Scale Farms Due to Price Fluctuations in 1999-2002. Calculated on a Non-Traded Farm-Gate Parity Price Basis

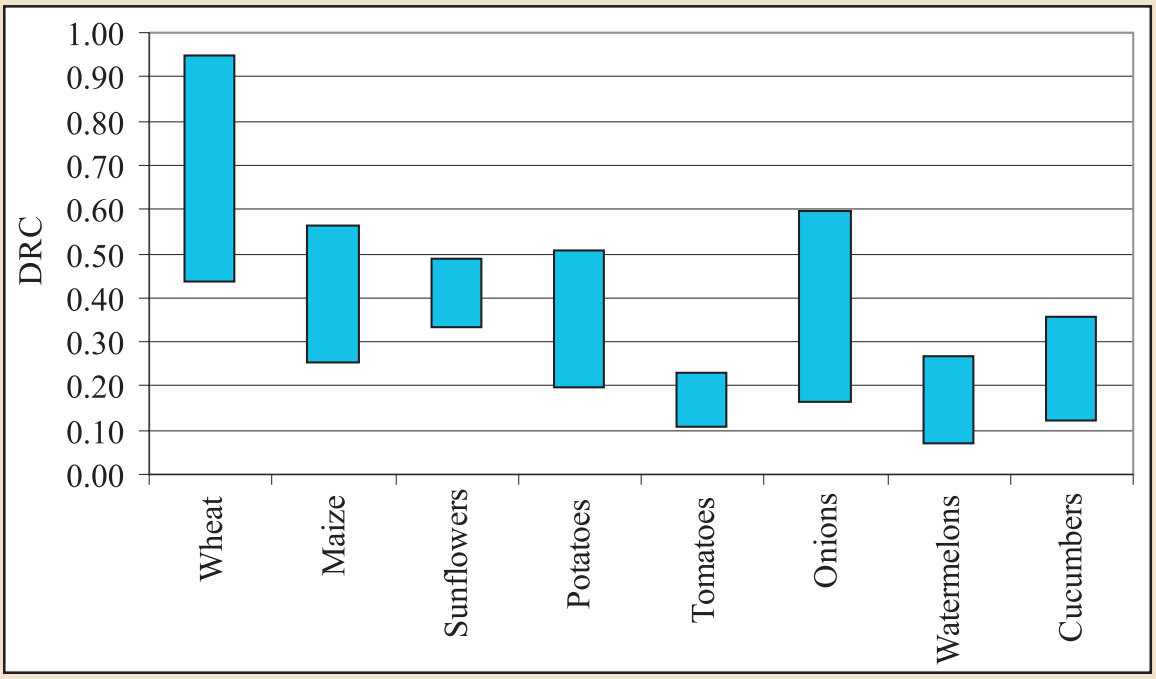

Figure 5.9. Variability of DRC Ratios of Crops on Small-Scale Household Farms Due to Price Fluctuations in 1999-2002. Calculated on a Non-Traded Farm-Gate Parity Basis

VI. Policy Analysis Matrix: Alternative Policy Scenarios

Effects of Current Policies and Market Failures

Policy analysis matrices of crop production enterprises for different scales of farming operations are presented in Tables 6.1-6.4. The effects of current policies can be broken into (1) direct policy effects resulting from any policy divergence on output and agricultural inputs; (2) indirect policy effects caused by divergences due to policies affecting the cost of imported machinery (cost of depreciation); and (3) the difference between private and social rates of interest affecting the impact of capital costs on profits, which is mainly reflected (hidden) in the prices (costs) of machinery and equipment service.

The PAMs of household farm enterprises presented in Table 6.1 show that, in general, domestic factors of production are under-priced, and tradable goods are overpriced. Although household farm enterprises have higher costs as a result of policies on imported inputs and failures in capital markets, these increases in costs are more than offset by the benefits they receive as a result of land price divergences (under pricing). The negative capital divergence results because the private interest rates that farmers pay are higher than the social rates as a result of constraints and limitations in the capital market. Overall and on the average, small-scale household farms experience a net gain from policy interventions and distortions that is mainly due to land price divergences. Small-scale household farms own about 75% of the agricultural land, and the private cost (price) of land they pay is lower than its real value. Also, as is indicated above, due to high levels of unemployment, the opportunity cost of family labor in household farms is very low. As a result of the implicit transfers of current policies, private profits of all crops are greater than corresponding social profits, especially for main crop enterprises. Policy intervention indicators presented in Table 6.6 for household farms show that profitability protection indicators for wheat, maize, and sunflowers are 1.85, 1.37, and 1.59, respectively. The subsidy ratios to producers vary from 0.06 to 0.27 showing the extent in which private revenue increases are associated with current policy distortions. These results indicate that under current policies and circumstances, small-scale household farms are potentially the most competitive type of farm enterprises in the agricultural sector.

Estimates of PAMs for average-scale commercial farm enterprises presented in Table 6.2 show negative divergences in profits for all crop enterprises. The divergences in profits are mainly due to the higher cost that average-scale commercial farmers have to pay to rent land. Policy intervention indicators presented in Table 6.7 for crop production enterprises in average-scale farms show profitability protection indicators of main crop production that are substantially reduced by policy transfers (distortions). In contrast to small-scale household farms, average-scale farmers are not implicitly subsidized by current policies. Subsidy ratios to producers are all negative (Table 6.7) Profits of average-scale farm enterprises are more sensitive to changes in prices and less price competitive than small-scale household farms. However, average-scale farmers could become as competitive as household farms through improvements in technology and farmers' skills.

Until recently, seed-producing farms were given the privilege to pay only a small amount to rent state-owned land. The amount of rent that farmers paid was equal to a land tax. Many large farms took advantage of this law to grow and produce crop outputs other than seeds (although they were only supposed to produce seeds). This happened at a time when the demand for seeds declined because many farmers began to use their own seeds. The preferential pricing of land to seed-producing farms was eliminated in recent years. However, this change has not been properly enforced in some areas of southern Kyrgyzstan. Some "seed-producing farms" are still renting state land to commercial farmers for a price higher than the price they pay to the state.

PAM estimates of large-scale farm enterprises (Table 6.3) are negatively affected by divergences caused by the pricing of agricultural inputs and capi-

Table 6.1. Policy Analysis Matrix of Household Farm Enterprises Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Prices					Social Prices					Divergences					Effect of Policies on Profit				
	Revenue	Tradable	Land	Labor	Profit	Revenue	Tradable	Land	Labor	Profit	Revenue	Tradable	Land	Labor	Profit	Direct	Land	Indirect	Capital	Remaining
	(Soms/ha)																			
Main Crops																				
Wheat	18,360	7,106	400	1,572	9,282	18,360	5,882	5,900	1,572	5,006	0	1,224	-5,500	0	4,276	-507	5,500	-246	-561	91
Maize	25,080	6,445	400	2,167	16,068	25,080	5,286	5,900	2,167	11,727	0	1,159	-5,500	0	4,341	-438	5,500	-248	-565	91
Sunflowers	22,650	2,646	400	2,256	17,349	22,650	2,172	5,900	2,256	12,323	0	474	-5,500	0	5,026	-243	5,500	-80	-181	29
Vegetable Crops																				
Potatoes	86,750	26,369	400	6,755	53,225	86,750	24,893	10,400	6,755	44,701	0	1,476	-10,000	0	8,524	-804	10,000	-231	-526	85
Tomatoes	75,500	9,302	400	4,901	60,897	75,500	7,628	5,900	4,901	57,071	0	1,674	-5,500	0	3,826	-1,124	5,500	-189	-430	70
Onions	95,400	12,830	400	7,979	74,192	95,400	11,377	10,400	7,979	65,645	0	1,453	-10,000	0	8,547	-1,041	10,000	-142	-323	52
Watermelons	80,400	4,260	400	4,946	70,794	80,400	3,626	5,900	4,946	65,928	0	635	-5,500	0	4,865	-443	5,500	-66	-150	24
Cucumbers	70,800	3,722	400	5,996	60,682	70,800	3,148	5,900	5,996	55,756	0	575	-5,500	0	4,925	-383	5,500	-66	-150	24

Table 6.2. Policy Analysis Matrix of Average-Scale Farm Enterprises Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Price					Social Prices					Divergences					Effect of Policies on Profit				
	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Direct	Land	Indirect	Capital	Remaining
	(Soms/ha)																			
Main Crops																				
Winter wheat	18,360	7,106	5,900	1,912	3,442	18,360	5,882	5,900	1,912	4,666	0	1,224	0	0	-1,224	-507	0	-246	-561	91
Cotton	41,100	12,617	5,900	8,509	14,074	41,100	10,184	5,900	8,509	16,507	0	2,433	0	0	-2,433	-1,376	0	-363	-827	134
Rice	57,300	6,226	11,750	6,464	32,860	57,300	5,421	11,750	6,464	33,664	0	804	0	0	-804	-581	0	-77	-175	28
Maize	25,080	6,445	5,900	2,967	9,768	25,080	5,286	5,900	2,967	10,927	0	1,159	0	0	-1,159	-438	0	-248	-565	91
Sunflowers	22,650	2,646	6,650	3,106	10,249	22,650	2,172	6,650	3,106	10,723	0	474	0	0	-474	-243	0	-80	-181	29
Barley	13,320	7,814	5,900	2,086	-2,479	13,320	6,285	5,900	2,086	-950	0	1,529	0	0	-1,529	-675	0	-293	-668	108
Vegetable Crops																				
Potatoes	86,750	26,369	10,400	11,755	38,225	86,750	24,893	10,400	11,755	39,701	0	1,476	0	0	-1,476	-804	0	-231	-526	85
Tomatoes	75,500	9,302	5,900	10,301	49,997	75,500	7,628	5,900	10,301	51,671	0	1,674	0	0	-1,674	-1,124	0	-189	-430	70
Onions	95,400	12,830	10,400	17,779	54,392	95,400	11,377	10,400	17,779	55,845	0	1,453	0	0	-1,453	-1,041	0	-142	-323	52
Watermelons	80,400	4,260	5,900	11,066	59,174	80,400	3,626	5,900	11,066	59,808	0	635	0	0	-635	-443	0	-66	-150	24
Cucumbers	70,800	3,722	5,900	13,516	47,662	70,800	3,148	5,900	13,516	48,236	0	575	0	0	-575	-383	0	-66	-150	24

Table 6.3. Policy Analysis Matrix of Large-Scale Farm Enterprises Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Prices					Social Prices					Divergences					Effect of Policies on Profit				
	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Direct	Land	Indirect	Capital	Remaining
	(Soms/ha)																			
Wheat	18,360	7,106	4,955	1,770	4,529	18,360	5,882	6,315	1,770	4,393	0	1,224	-1,360	0	136	-507	1,360	-246	-561	91
Cotton	41,100	12,617	4,955	7,615	15,913	41,100	10,184	6,315	7,615	16,986	0	2,433	-1,360	0	-1,073	-1,376	1,360	-363	-827	134
Maize	25,080	6,445	4,955	2,575	11,105	25,080	5,286	6,315	2,575	10,905	0	1,159	-1,360	0	201	-438	1,360	-248	-565	91
Sunflowers	22,650	2,646	5,705	3,975	10,324	22,650	2,172	7,065	3,975	9,438	0	474	-1,360	0	886	-243	1,360	-80	-181	29
Barley	13,320	7,814	4,955	1,770	-1,219	13,320	6,285	6,315	1,770	-1,050	0	1,529	-1,360	0	-169	-675	1,360	-293	-668	108

Table 6.4. Estimated Impact of a 20% VAT on Crop Outputs on Large-Scale Farm Enterprises Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Prices					Social Prices					Divergences					Effect of Policies on Profit				
	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Direct	Land	Indirect	Capital	Remaining
	(Soms/ha)																			
Winter wheat	15,300	7,106	4,955	1,770	1,469	18,360	5,882	6,315	1,770	4,393	-3,060	1,224	-1,360	0	-2,924	-3,567	1,360	-246	-561	91
Cotton	34,250	12,617	4,955	7,615	9,063	41,100	10,184	6,315	7,615	16,986	-6,850	2,433	-1,360	0	-7,923	-8,226	1,360	-363	-827	134
Maize	20,900	6,445	4,955	2,575	6,925	25,080	5,286	6,315	2,575	10,905	-4,180	1,159	-1,360	0	-3,979	-4,618	1,360	-248	-565	91
Sunflowers	18,875	2,646	5,705	3,975	6,549	22,650	2,172	7,065	3,975	9,438	-3,775	474	-1,360	0	-2,889	-4,018	1,360	-80	-181	29
Barley	11,100	7,814	4,955	1,770	-3,439	13,320	6,285	6,315	1,770	-1,050	-2,220	1,529	-1,360	0	-2,389	-2,895	1,360	-293	-668	108

Table 6.5. Policy Analysis Matrix of Greenhouse Farm Enterprises Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Prices					Social Prices					Divergences					Effect of Policies on Profit				
	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Revenue	Tradable	Capital	Labor	Profit	Direct	Land	Indirect	Capital	Remaining
	Soms/ha)																			
Tomatoes	397,200	17,743	66,090	1,207	312,160	397,200	15,736	57,090	1,207	323,167	0	2,007	9,000	0	-11,007	-10,986	0	-7	-17	3
Cucumbers	427,800	38,334	66,090	1,277	322,099	427,800	36,466	57,090	1,277	332,967	0	1,868	9,000	0	-10,868	-10,847	0	-7	-17	3
Watermelons	43,110	11,459	28,290	892	2,469	43,110	9,659	25,590	892	6,969	0	1,800	2,700	0	-4,500	-4,479	0	-7	-17	3

Table 6.6. Policy Intervention Indicators Derived From PAMs of Crops in Small-Scale Farms Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Cost Ratio	Domestic Resource Cost Ratio	Nominal Protection Coefficient for Outputs	Nominal Protection Coefficient for Inputs	Effective Protection Coefficient	Profitability Protection	Subsidy Ratio to Producers
Main Crops							
Wheat	0.18	0.60	1.00	1.21	0.90	1.85	0.23
Maize	0.14	0.41	1.00	1.22	0.94	1.37	0.17
Sunflowers	0.16	0.49	1.00	1.22	0.97	1.59	0.27
Vegetable Crops							
Potatoes	0.12	0.28	1.00	1.06	0.98	1.19	0.10
Tomatoes	0.08	0.16	1.00	1.22	0.98	1.07	0.05
Onions	0.10	0.22	1.00	1.13	0.98	1.13	0.09
Watermelons	0.07	0.14	1.00	1.18	0.99	1.07	0.06
Cucumbers	0.10	0.18	1.00	1.18	0.99	1.09	0.07

Table 6.7. Policy Intervention Indicators Derived From PAMs of Crops in Average-Scale Farms Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Cost Ratio	Domestic Resource Cost Ratio	Nominal Protection Coefficient for Outputs	Nominal Protection Coefficient For Inputs	Effective Protection Coefficient	Profitability Protection	Subsidy Ratio to Producers
Main crops							
Wheat	0.69	0.63	1.00	1.21	0.90	0.74	-0.07
Cotton	0.51	0.47	1.00	1.24	0.92	0.85	-0.06
Rice	0.36	0.35	1.00	1.15	0.98	0.98	-0.01
Maize	0.48	0.45	1.00	1.22	0.94	0.89	-0.05
Sunflowers	0.49	0.48	1.00	1.22	0.98	0.96	-0.02
Barley	1.45	1.14	1.00	1.24	0.78	2.61	-0.11
Vegetable Crops							
Potatoes	0.37	0.36	1.00	1.06	0.98	0.96	-0.02
Tomatoes	0.24	0.24	1.00	1.22	0.98	0.97	-0.02
Onions	0.34	0.34	1.00	1.13	0.98	0.97	-0.02
Watermelons	0.22	0.22	1.00	1.18	0.99	0.99	-0.01
Cucumbers	0.29	0.29	1.00	1.18	0.99	0.99	-0.01

tal but positively affected by gains in the pricing of land. The net effects of these divergences on profits are positive for maize, wheat, and sunflower but negative for cotton and barley. In cotton, where agricultural inputs and machinery are intensively used, the highest divergence is observed in the tradable column.

The estimated impact of imposing a VAT of 20% on crop outputs of large-scale farms is presented in the PAMs shown in Table 6.4. Legislation adopted early this year established this tax that targets large-scale farms. Large farms are expected to pay a 20% VAT on the sale of crop outputs in excess of annual revenue of 300,000 Soms per farm. Results shown

in Tables 6.4 and 6.8 clearly indicate that large-scale farms will be greatly hampered by this tax. Indicators of profitability protection varying from 0.33 to 0.69 (Table 6.8) show that the 20% VAT is a very distorting policy that reduces private profits substantially and may have a significant adverse impact on the development of the agricultural sector.

PAM estimates presented in Table 6.5 and policy intervention indicators shown in Table 6.9 for greenhouse farm enterprises indicate that (as is expected) greenhouse farm enterprises intensively employing tradable agricultural inputs and electricity (non-tradable) are negatively impacted by the VAT on these inputs. However, profitability protection ratios for tomatoes and cucumbers are not reduced more than is shown in the case of main crops (Table 6.9). Considering that greenhouse farming is not well developed in southern Kyrgyzstan and that vegetables are usually imported illegally from Uzbekistan in the winter, the 20% VAT on output would seriously affect the profitability and development of domestic producers. This tax could greatly impede greenhouse development because domestic production will lose price competitiveness with respect to Uzbekistan products.

Land Tax as an Alternative to VAT on Agricultural Inputs

Import taxes and tariffs have always had two main purposes and effects; one is to generate revenues for governments to finance public expenditures, and the second is to serve as instruments of protection and control. Because the tax base in developing countries is often very small, it is a challenging undertaking to find tax policies that achieve a good balance between the objectives of economic development and revenue generation to prevent government budget deficits. An example of this would be the campaign conducted by the Association of Agribusiness Entrepreneurs of Kyrgyzstan toward

Table 6.8. Policy Intervention Indicators Derived From PAMs of Crops in Large-Scale Farms Under a 20% VAT on Outputs. Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Cost Ratio	Domestic Resource Cost Ratio	Nominal Protection Coefficient for Outputs	Nominal Protection Coefficient for Inputs	Effective Protection Coefficient	Profitability Protection	Subsidy Ratio to Producers
Wheat	0.82	0.65	0.83	1.21	0.66	0.33	-0.16
Cotton	0.44	0.36	0.83	1.24	0.73	0.63	-0.19
Maize	0.52	0.45	0.83	1.22	0.73	0.64	-0.16
Sunflowers	0.60	0.54	0.83	1.22	0.79	0.69	-0.13
Barley	2.05	1.15	0.83	1.24	0.47	3.28	-0.18

Table 6.9. Policy Intervention Indicators Derived From PAMs of Greenhouse Farms. Calculated Using Average 1999-2002 Non-Traded Farm-Gate Parity Prices

Items	Private Cost Ratio	Domestic Resource Cost Ratio	Nominal Protection Coefficient for Outputs	Nominal Protection Coefficient for Inputs	Effective Protection Coefficient	Profitability Protection	Subsidy Ratio to Producers
Tomatoes	0.18	0.15	1.00	1.13	0.99	0.97	-0.03
Cucumbers	0.17	0.15	1.00	1.05	1.00	0.97	-0.03
Watermelons	0.92	0.79	1.00	1.19	0.95	0.35	-0.10

a reduction of the VAT on imported agricultural inputs. The resistance received shows how adamantly opposed the government is to any reduction of this tax.

A VAT on imports administered at the country's borders is considered to be very efficient and easy to manage and control because it is imposed when the commodities (inputs) are physically crossing the border. However, because agricultural land is the most non-tradable and immobile factor of production and its value is hardly affected by events in other sectors of the economy, agricultural land can serve as an efficient base for taxation to generate government revenues.

Recent years' data show that in southern Kyrgyzstan the cost of renting land in a given year is greatly affected by the profits obtained from that land in the previous year. This is consistent with the fact that the price of land is determined by the economic returns to land. Thus, any changes in factors affecting the profitability and returns to land such as crop yields and output prices will affect the price of land and the cost of renting land. For example, the high price of cotton in 2000 contributed to a significant increase in the cost of renting land in the following year, and a decline in the price of cotton in 2001 contributed to a decrease in the cost of renting land in 2002.

Taxes on agricultural inputs or outputs affect the profitability of crop production, returns to land, and thereby the price (rent) of land. Thus, having a tax on land rather than on agricultural inputs and/or outputs should not necessarily affect adversely the profitability of farmers renting land. A tax on land would simplify and facilitate tax collection procedures and may motivate farmers and households to intensify the use of modern agricultural inputs to increase land productivity and optimize the allocation of resources as is shown in Figure 6.1. A tax on

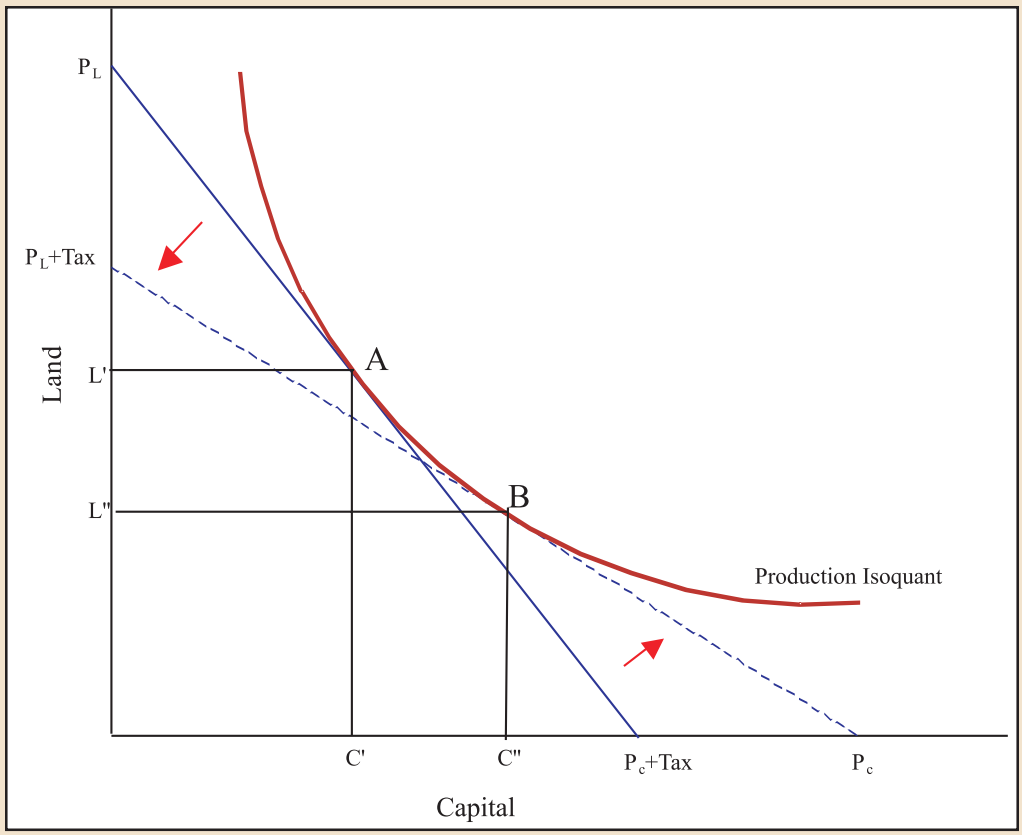

Figure 6.1. The Effects of Replacing the VAT on Agricultural Inputs With a Tax on Land

land is expected to influence farmers' behavior towards the use of land, capital, and agricultural inputs. A tax on land will increase the price (cost) of land relative to other factors of production and variable inputs. The decrease in the relative agricultural inputs/land prices caused by the land tax will provide an increased incentive for farmers to use modern agricultural inputs and improve crop production technology. In Figure 6.1, a land tax will cause the isocost line to become flatter (dashed line) and result in the substitution (reallocation) of resources indicated by the movement from point A to B. The new optimal point of resource allocation implies a relative increase in capital intensity. In this static analysis, the production isoquant remains the same and shows that farmers change resource allocation but levels of production remain the same. However, if the increased use of modern agricultural inputs embodies technical improvement, then the production possibility frontier and the isoquant will shift upward. Then all farmers, landowners, and farmers renting land will benefit. This outcome will be enhanced if in conjunction with the land tax policies, programs are implemented to facilitate the transfer of improved production technology to farmers.

Rough estimates of the divergences caused by the VAT on the imports of agricultural inputs on each crop are presented in Table 6.10. It is estimated here that if all agricultural inputs supplied to farmers were legally imported, the current VAT would generate revenue of about 430 million Soms to the government budget. In reality, however, most agricultural inputs supplied to farmers in southern Kyrgyzstan are not legally imported. For example, the government revenue from imported agricultural inputs in southern Kyrgyzstan was about 2.4 million Soms or about 8 Soms/ha in 2001, which is less than 2% of our estimate of 428 Soms/ha. That would mean that more than 98% of the agricultural inputs supply in southern Kyrgyzstan is from illegally imported sources that do not pay the VAT.

If the government, in order to maintain a balanced budget, cannot reduce tax revenues, it will be useful to consider replacing the VAT on agricultural inputs with a tax on land. The estimated impacts of replacing the current VAT tax on agricultural inputs with a land tax of 450 Soms/ha/year are presented in Table 6.11. These estimates show the expected consequences of removing the VAT on agricultural inputs and increasing land taxes by 450 Soms/ha/year on the profitability and comparative advantage of crop production in southern Kyrgyzstan. Although these estimates do not account for the impact on profits that may result from the expected increased

Table 6.10. Estimates of Divergences Caused by the VAT on Imported Agricultural Inputs on the Agricultural Sector of Kyrgyzstan.

	Divergence	Land Used[a]	Total Divergence
		(ha)	(Soms)
Wheat	362	502,154	181,528,615
Cotton	636	192,831	122,640,441
Rice	504	6,985	3,520,588
Maize	279	70,877	19,739,379
Sunflowers	158	66,286	10,440,000
Barley	432	68,230	29,475,556
Potatoes	597	78,239	46,708,679
Tomatoes[a]	970	8,000	7,760,000
Onions[a]	938	7,500	7,035,000
Watermelons[a]	368	5,000	1,840,000
Cucumbers[a]	305	3,000	915,000
Total		1,009,103	431,603,259
Policy Effect per ha			428

a. Approximate estimates.

Table 6.11. Effects of Removing the VAT on Agricultural Inputs and Increasing Land Taxes by 450 Soms/ha/Year.

Items	Private Profit (Soms/ha)		Economic Profit	DRC Ratios	PCR		Profitability Coefficient		Effects on Private Profit
	Before	After			Before	After	Before	After	
			(Soms/ha)						(Soms/ha)
Main Crops									
Wheat	3,442	3,305	4,666	0.63	0.69	0.71	0.74	0.71	-137
Cotton	14,074	14,171	16,507	0.47	0.51	0.51	0.85	0.86	97
Rice	32,860	32,852	33,664	0.35	0.36	0.36	0.98	0.99	-8
Maize	9,768	9,557	10,927	0.45	0.48	0.49	0.89	0.87	-211
Sunflowers	10,249	9,933	10,723	0.48	0.49	0.51	0.96	0.93	-316
Barley	-2,479	-2,557	-950	1.14	1.45	1.44	2.61	2.74	-78
Vegetable Crops									
Potatoes	38,225	38,269	39,701	0.36	0.37	0.52	0.96	0.94	44
Tomatoes	49,997	50,217	51,671	0.24	0.24	0.25	0.97	0.97	219
Onions	54,392	54,770	55,845	0.34	0.34	0.34	0.97	0.98	378
Watermelons	59,174	59,047	59,808	0.22	0.22	0.23	0.99	0.99	-127
Greenhouse Vegetables									
Tomatoes	312,160	323,811	323,167	0.15	0.18	0.15	0.97	0.97	11,651
Cucumbers	322,099	333,710	332,967	0.15	0.17	0.14	0.97	0.97	11,611
Watermelons	2,469	8,007	6,969	0.79	0.92	0.69	0.35	0.64	5,539

use of agricultural inputs caused by the lower prices (and taxes), they provide a good basis for assessing the expected impacts of a change in tax policies. These estimates show that crop production enterprises that use agricultural inputs more intensively such as cotton, potatoes, onions, tomatoes, and all greenhouse vegetables would be more profitable as a result of the new policy even if the rates of use of agricultural inputs remain constant. Crops with relatively less intensive use of agricultural inputs such as wheat, maize, sunflowers, and watermelons, show a small decline in profitability that might be partially or totally offset by the benefits associated with the increased use of agricultural inputs that are unaccounted for.

Here we have used the PAM method to evaluate in a simple manner a possible change in tax policy concerning land and agro-input taxes. It is important to note however that taxes on agricultural land can have other effects on overall economic development and growth that should be properly assessed.

The Effect of VAT at International Borders on Competitiveness

Poor trade policies of Central Asian countries are sources of important constraints to agricultural development in the region. Value-added taxes (VAT) imposed on commodities as they cross international borders are important barriers to international trade in the region. Estimates of the expected impact of removing a 16% VAT on imports by Kazakhstan on the profitability and comparative advantage of crop production in southern Kyrgyzstan for exports to Kazakhstan are shown in Table 6.12. These estimates clearly illustrate the consequences of removing trade barriers.

Estimates of profitability coefficients measuring private profits with respect to social profits show the considerable distortion caused by the VAT imposed on the border. These results show that (1) this trade barrier substantially and adversely affects the profitability of potato production for exports to Kazakhstan, (2) rice and maize production would

Table 6.12. Effects of Removing a 16% VAT on Imports by Kazakhstan on the Profitability and Comparative Advantage of Crop Production in Southern Kyrgyzstan for Exports to Kazakhstan

Items	Private Profit		Economic Profit	PCR		PCR (Domestic)	Profitability Coefficient	
	Before	After		Before	After		Before	After
Rice	16,810	24,310	25,114	0.52	0.43	0.36	0.67	0.97
Maize	-1,092	3,048	4,207	1.14	0.74	0.48	-	0.72
Potatoes	20,225	39,475	40,951	0.52	0.36	0.37	0.49	0.96
Tomatoes	170,497	217,297	218,971	0.09	0.07	0.24	0.78	0.99
Onions	89,042	125,042	126,495	0.24	0.18	0.34	0.70	0.99
Watermelons	85,574	123,374	126,108	0.17	0.12	0.22	0.68	0.98

still be more competitive for domestic markets rather than at export parity prices if the barrier is removed, and (3) maize production improves in efficiency at export parity prices if the VAT is removed. The removal of this trade barrier will improve the profitability and efficiency of potato production for exports to Kazakhstan; this will become as competitive for exports as it is for the domestic market. The private profitability of tomato, onion, and watermelon production will be substantially improved if the VAT barrier is removed. These results show that both countries, Kyrgyzstan and Kazakhstan, will gain as a result of increased free trade.

Trade agreements to eliminate trade barriers and promote trade that will benefit countries in the region should be encouraged. A common objective of most Central Asian countries is to achieve food security by increasing domestic wheat production to become self-sufficient in grain consumption. Almost all countries in the region pursue this objective although it is recognized that Kazakhstan is the most competitive producer of wheat in the region and, according to the Kazakh Ministry of Agriculture, Kazakhstan will become the world's sixth largest exporter of wheat this year.

Almost one-half of the agricultural land of Kyrgyzstan was used for wheat production in 2002, and the government had to impose a 20% tariff on wheat imports for 2 months to protect local farmers when the price of wheat declined as a result of excess supply in the domestic market. Kyrgyzstan moved toward the increased production of wheat in the early 1990s after the collapse of the livestock sector (Figure 6.2). Although there is only a moderate comparative advantage for wheat production in Kyrgyzstan for domestic consumption, the country would probably be forced to increase the production of wheat to meet domestic demand and food security goals until appropriate trade agreements and policies with neighboring and other countries are established. Assessments of comparative advantages for crop production in neighboring countries similar to the one done here for southern Kyrgyzstan will provide information useful to identify trade patterns (and agreements) that will benefit countries in the region.

Kyrgyzstan has been a member of the World Trade Organization (WTO) since November 1998. Because the WTO prohibits subsidies on exports, Kyrgyzstan cannot subsidize agricultural production to promote exports. However, as a developing country, Kyrgyzstan can adopt certain measures such as regional developmental programs, agricultural restructuring procedures, disease control policies, and food security plans that can facilitate agricultural and economic development. Kyrgyzstan is also a member of the Central-Asian Economic Union (CAEU) regional trade association and the Customs Union, which also includes Russia, Belarus, and Kazakhstan and officially intends to establish a free trade region among its members.

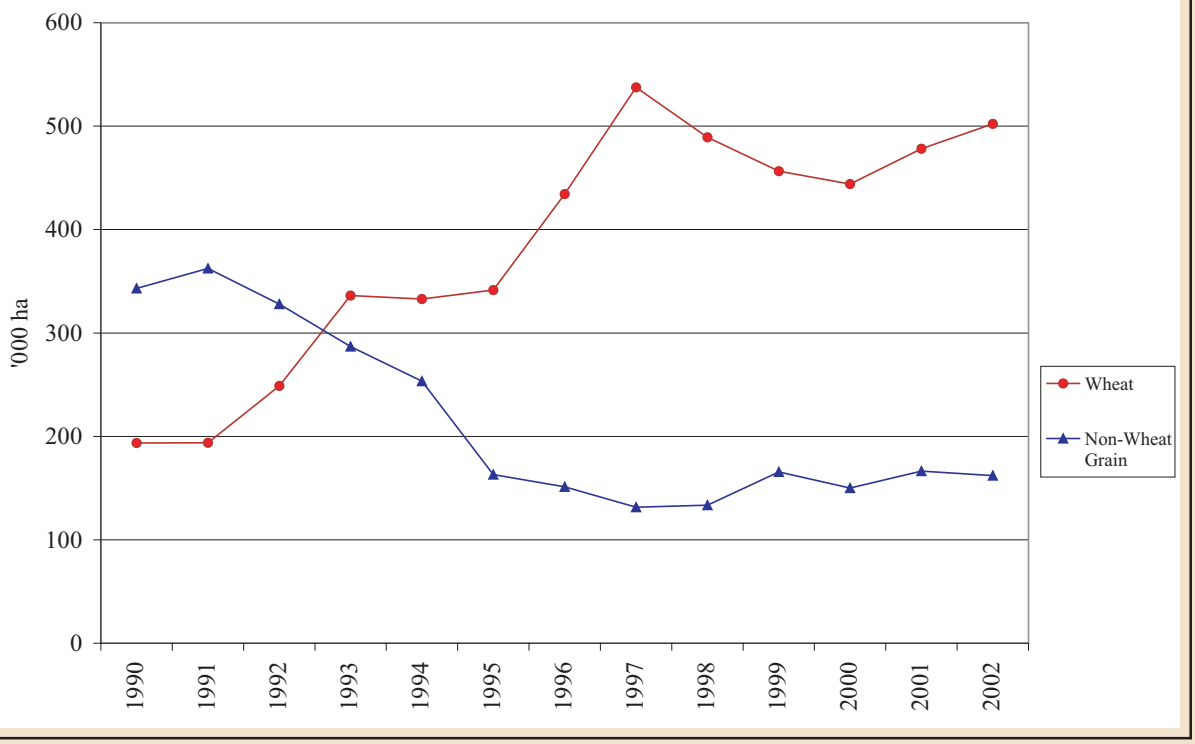

Figure 6.2. Trends in Wheat and Non-Wheat Grain Production in Kyrgyzstan

VII. Summary of Results and Conclusions

The most important results of the study are summarized below. In the first section, the main results on the comparative advantage of crop production in southern Kyrgyzstan are presented; in the second section, the implications of the results of the study for the design of policies and development assistance programs are summarized.

Comparative Advantages of Crop Production—Summaries of the results of analyses conducted using the PAM method to evaluate the comparative advantages of crop production in southern Kyrgyzstan are presented in Tables 7.1 and 7.2. These results are presented in the form of assessments conducted to determine the relative comparative advantages and potential for crop production in southern Kyrgyzstan to (1) meet the demand and consumption of the domestic market (Table 7.1) and (2) substitute imports and promote the exports of agricultural products (Table 7.2). These tables clearly show the indicators of profitability and the comparative advantage in conjunction with assessments of perceived risk and technical and financial constraints for all the farm-crop production enterprises included in the analysis. On the basis of these indicators, assessments, and general observations,

Table 7.1. Assessment of Comparative Advantages and Potential of Crop Production in Southern Kyrgyzstan for the Domestic Market

Farm-Crop Enterprises			Indicators			Risk	Key Constraints		Ranking
Type of Farm	Crop Group	Crops	Private Profits	Social Profits	DRC Ratios		Technical	Financial	
			(Soms/ha)						
Small-scale	Vegetables	Tomatoes	60,897	57,071	0.16	average	high	high	1
		Onions	74,192	65,645	0.22	average	high	high	1
		Watermelons	70,794	65,928	0.14	average	average	high	1
		Cucumbers	60,682	55,756	0.18	average	average	high	1
		Potatoes	53,225	44,701	0.28	average	average	high	2
	Main	Maize	16,068	11,727	0.41	low	average	low	3
		Sunflowers	17,349	12,323	0.40	low	low	low	3
		Wheat	9,282	5,006	0.60	high	low	low	4
Average-scale	Vegetables	Watermelons	59,174	103,908	0.22	average	average	high	1
		Cucumbers	47,662	136,636	0.29	average	average	high	1
		Tomatoes	49,997	72,671	0.24	average	high	high	1
		Onions	54,392	95,220	0.34	average	high	high	2
		Potatoes	38,225	66,085	0.36	average	average	high	2
	Main	Rice	32,860	33,664	0.35	low	average	average	2
		Cotton	14,074	16,507	0.47	low	average	average	3
		Maize	9,768	10,927	0.45	low	average	low	3
		Sunflowers	10,249	10,723	0.48	low	low	low	3
		Wheat	3,442	4,666	0.63	high	low	low	4
		Barley	(2,479)	(950)	1.14	high	low	low	5
Large-scale	Main	Cotton	15,913	16,986	0.45	low	average	average	1
		Maize	11,105	10,904	0.45	low	average	low	1
		Sunflowers	10,324	9,438	0.54	low	low	low	2
		Wheat	4,529	4,393	0.65	high	low	low	3
		Barley	(1,219)	(1,050)	1.15	high	low	low	4
Greenhouse	Vegetables	Tomatoes	312,160	323,167	0.15	low	high	high	1
		Cucumbers	322,099	332,967	0.15	low	high	high	1
		Watermelons	2,469	6,969	0.79	average	high	high	2

Table 7.2. Assessment of Comparative Advantages and Potential Of Crop Production in Southern Kyrgyzstan for Export Promotion and Import Substitution

Farm-Crop Enterprises			Indicators				Risk	Key Constraints		Ranking
Type of Farm	Crop Group	Crops	Export(E) Import(I)	Private Profits	Social Profits	DRC Ratios		Technical	Financial	
				(Soms/ha)						
Small-scale	Vegetables	Tomatoes	E	181,397	224,371	0.05	low	high	high	1
		Onions	E	108,842	136,295	0.12	average	high	high	1
		Watermelons	E	97,194	131,028	0.07	low	high	high	1
		Potatoes	E	35,225	45,951	0.27	average	high	high	2
	Main	Maize	E	5,208	5,007	0.62	average	low	high	3
		Maize	I	26,992	17,167	0.32	low	low	low	2
		Wheat	I	11,633	4,637	0.62	high	low	low	3
Average-scale	Vegetables	Tomatoes	E	170,497	218,971	0.07	low	high	high	1
		Watermelons	E	85,574	126,108	0.11	low	high	high	1
		Onions	E	89,042	126,495	0.18	average	high	high	2
		Potatoes	E	20,225	40,951	0.35	average	high	high	3
	Main	Cotton	E	22,148	24,580	0.37	low	high	average	3
		Rice	E	16,810	25,114	0.42	average	average	average	3
		Maize	I	20,692	16,367	0.35	low	low	low	3
		Rice	I	17,921	11,838	0.61	average	average	average	4
		Wheat	I	5,793	4,297	0.65	high	low	low	4
		Maize	E	(1,092)	4,207	0.68	low	low	low	5
Large-scale	Main	Cotton	E	23,987	25,059	0.36	low	high	average	1
		Maize	I	22,029	16,344	0.35	low	low	low	1
		Wheat	I	6,881	4,025	0.67	high	low	low	2
		Maize	E	245	4,184	0.68	low	low	low	2
Greenhouse	Vegetables	Tomatoes	I	356,560	287,157	0.18	low	high	high	1
		Cucumbers	I	397,070	321,604	0.17	low	high	high	1
		Watermelons	I	11,331	6,719	0.80	average	high	high	2

the potential for the efficient use of resources in crop production is specified by the ranking of crop production enterprises within each type of farm category and associated scales of operation.

The following general conclusions on the comparative advantage and potential of crop production in southern Kyrgyzstan can be drawn from the results summarized and presented in Tables 7.1 and 7.2:

1. The resources of small- and average-scale farmers can be efficiently used for the production of vegetables to meet the demand of the domestic market and also potentially for the export market. These farmers have a strong comparative advantage to produce tomatoes, onions, watermelons, cucumbers, and potatoes for the domestic market and tomatoes, onions, and watermelons for the export market. Estimates of indicators show that small- and average-scale farmers can obtain high profits and allocate resources in a manner that is efficient for the private and social interest. It is important to understand, however, that the estimated profits and, more importantly, the profits that farmers would realize from these crops will depend fundamentally on the stability of output prices. Prices can rapidly and substantially decline in response to the overproduction and excess supply of vegetable products that are perishable and difficult to store. Improvements in the marketing, storage, distribution, and processing of vegetable products are required to reduce the output price volatility that has characterized the market for vegetables in southern Kyrgyzstan in recent years. With respect to veg-

etable production for exports, the production and handling of export-quality vegetables involve the adoption of modern technology to produce, market, and process vegetables properly. Therefore, important technical and financial constraints must be overcome if the apparent comparative advantage of vegetable crop production is to be realized by small and average-scale farmers in southern Kyrgyzstan.

2. It is important to note that if the benefits of increasing vegetable production to meet the demand of the domestic market and to boost exports are realized, the incomes of small-scale farmers and the rural labor force in southern Kyrgyzstan should increase significantly, and there will be important gains in foreign exchange. Thus, increasing vegetable production on an economically sound and sustainable basis could have an important positive impact on poverty alleviation and the balance of trade of Kyrgyzstan.

3. Small-scale farmers also have good comparative advantages to produce (1) maize for the domestic market as a non-tradable commodity and to substitute imports and (2) sunflowers to meet the domestic demand. These two crops have lower risk and less technical and financial constraints than the vegetable crops. Small- and average-scale farmers have only a moderate comparative advantage to produce wheat, but they are expected to continue to produce wheat for food security reasons and, if needed, to substitute imports. In addition to low prices of wheat in the world market, poor yields on about half of the agricultural land undermine the efficiency of wheat production. Because of the current structure of the flour mill industry, most of the profits of wheat production and processing are captured by the flour mills. Thus, a better distribution of profits between the farmers and the flour mills could significantly increase the profitability and comparative advantage of wheat production for the domestic market. The flour mill industry should be appropriately developed and competition enhanced.

4. Average-scale farmers have good comparative advantages to produce (1) rice, cotton, maize, and sunflowers for the domestic market and (2) cotton and maize for exports and import substitution, respectively. These farmers have only a moderate comparative advantage to produce wheat for domestic consumption and to substitute imports.

5. Large-scale farmers can use their resources more efficiently in the production of cotton for the export market, maize to substitute imports, and both crops in addition to sunflowers to satisfy the domestic demand. As is the case for average-scale farmers, these farmers also have only a moderate comparative advantage to produce wheat for domestic consumption and to substitute imports.

6. The profitability of barley production under current conditions is negative. Thus, unless market conditions change, the production of barley by average and large-scale farmers should be discouraged.

7. Greenhouse production of tomatoes and cucumbers is apparently very profitable capital-intensive enterprises that can use resources efficiently to achieve high levels of private and social (economic) profits and low domestic resource cost ratios. Comparative advantages of these enterprises in southern Kyrgyzstan are very strong for the production of tomatoes and cucumbers for the domestic market and to substitute imports, especially during the winter season. Unfortunately, most of the caveats indicated above about the production of open-field vegetables also apply to these greenhouse production enterprises but with significantly greater requirements for capital investment (financial constraints), technical know-how (technical constraints) and entrepreneurial capacity. Investments in these enterprises should be carefully evaluated and compared with alternative investment opportunities considering levels of risk and uncertainty. Results concerning the greenhouse production of watermelons are not encouraging.

Implications for Policy Design and Development Assistance—The evaluation of comparative advantages of crop production in southern Kyrgyzstan that was conducted using the PAM

method provides very useful information to identify policy issues that should be addressed and development assistance programs that should be considered to promote the development of the agricultural sector in Kyrgyzstan. The implications of the results and information presented above and of additional analyses conducted as part of this evaluation are used here to identify the following policy issues and needs for development assistance programs that should be addressed:

1. The VAT that is currently imposed on agricultural input imports increases the prices and reduces the use of inputs such as fertilizers and crop protection products that are essential to increase the productivity of crop production in southern Kyrgyzstan. This tax was established mainly to generate revenues needed by the government to maintain a balanced budget, but given the adverse effects the tax has on agricultural development, serious consideration should be given to the removal of the tax. Alternative tax policies that are less detrimental to the economic development of Kyrgyzstan should be considered and evaluated as a means of government revenue. In this study, the possible replacement of this tax with a tax on land is evaluated using the PAM method as a tool for analysis. It is estimated here that less than 5% of the agricultural inputs supply in the country are legally imported and pay the VAT. Thus, it is apparent that this tax is not a very effective way to generate government revenue.

2. Large farms are expected to pay a 20% VAT on the sale of crop outputs in excess of annual revenue of 300,000 Soms per farm. Results of analysis conducted in this study on the consequences of this tax indicate that large-scale farms will be greatly hampered by this tax. Indicators of profitability protection show that the 20% VAT is a very distorting policy that reduces private profits substantially and may have a significant adverse impact on the ability of large-scale farmers to compete in the production of crops such as cotton for the export market. This is a policy issue that needs to be revisited and addressed.

3. An in-depth assessment of the feasibility to invest in facilities and infrastructure for storage, marketing, and processing of vegetable products will greatly facilitate the decision-making on the implementation of these investments. Improvements in the storage, marketing, and processing of vegetable products are needed to realize the benefits of an increased production of vegetables by small- and average-scale farmers, having evident comparative advantages in the production of these crops.

4. Financial constraints are often severe impediments to the establishment of modern crop production enterprises and to the adoption of improved technology. Access of farmers and agribusiness entrepreneurs to financial resources is critical to the success of efforts and programs to promote improvements in the productivity and competitiveness of crop production. Policies and programs to facilitate the availability of credit to farmers and agribusinesses should be considered as key components of efforts to enhance the success of increased crop production, in general, and of export crops, in particular. Financial resources are needed to facilitate the production and export of vegetables and main crops that can be efficiently produced in southern Kyrgyzstan with strong comparative advantages.

5. Constraints to the access and adoption of improved technology for crop production and agribusiness development usually are the other main obstacles to the establishment of crop production and agribusiness enterprises that can efficiently produce and supply agricultural products to the domestic and import markets. Programs to facilitate the development and transfer of improved technology to farmers and agribusiness entrepreneurs are needed in Kyrgyzstan to enhance the success of crop production and agribusiness enterprises in a highly competitive export market. The potential for yield increases of various crops in Kyrgyzstan requires further detailed analysis and should be studied separately. A project conducted by IFDC in southern Kyrgyzstan is assisting in the development of technology transfer centers that have been researching crop seed varieties and different management practices to identify technologies that can be adopted by farmers to increase crop yields

and improve economic efficiency. Improvements in the technical and entrepreneurial expertise of farmers and agribusinesses and a skilled labor force can significantly enhance the success of development programs in general and the continuous competitiveness of crop production and agribusiness enterprises, in particular.

6. Although the PAM method is based on static analysis that fails to account for the dynamic consequences of changes over time, the method is useful to obtain valuable information about the comparative advantages of crop production enterprises in a given country or region within a country at a given point in time. If assessments of comparative advantages for crop production similar to the one done here for southern Kyrgyzstan are conducted in neighboring countries (and potential trading partners), it will be possible to better identify trade patterns that will benefit two or more countries in the region. This information can then serve as a basis for the establishment of a trade agreement that provides mutual benefits to the countries involved.

7. Trade agreements are very useful to promote trade that stimulates economic development and provides benefits to participating countries. Trade agreements facilitate the growth and stability of export-oriented enterprises and tend to reduce the risks and uncertainties associated with a highly competitive international market. In this regard, trade agreements are particularly important and beneficial to countries with relatively small economies such as Kyrgyzstan.

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Appendices

Appendix A: Key Assumptions

Table A.1. Exchange Rate, Interest Rate, and Land and Labor Costs

Details	Private	Social
Exchange rate (Soms per US $1)	46.00	46.00
Annual interest rate (%)	18.00	9.00
Skilled labor, Soms/hour	15.00	15.00
Tractor driver, Soms/hour	10.00	10.00
Unskilled labor, Soms/hour:		
Large- and average-scale farms	7.00	7.00
Households	3.00	3.00
Land rent, Soms/ha		
Large farms	3,300.00	5,500.00
Small farms	5,500.00	5,500.00
Households	0.00	5,500.00
Land tax, Soms/ha		
Large farms	420.00	0.00
Small farms	0.00	0.00
Water, Soms	400.00	400.00
Social fund, Soms/ha		
Large farms	420.00	0.00
Small farms	0.00	0.00

Table A.2. Fixed Costs of Large-Scale Farms

Details	Hours/ha	Private	Social
		Soms/ha	
Building		115	115
Staff skilled	35	525	525
Staff unskilled	50	350	350
Tractor driver	30	300	300
Utilities (electricity, phone, etc.)		130	130

Table B.1. Depreciation Costs of Machinery Per Hour—Private Prices

Details	Private Prices									
	Tractor (MTZ-82)	Tractor (DT-75)	Combine Harvester Mega 204	Spraying Machine	Plow	Harrow	Cultivator	Sowing Machine	Fuel	Grease, Oil
									(L)	
F.O.B. ($/unit)	8,950	17,250	140,000	2,300	180	500	1,100	1,900	0.180	0.540
Freight and Insurance ($/unit)	800	1,200	1,400	345	27	75	165	285	0.020	0.050
C.I.F ($/unit)	9,750	18,450	141,400	2,645	207	575	1,265	2,185	0.200	0.590
Official Exchange Rate (Soms/$)	46	46	46	46	46	46	46	46	46	46
Exchange Rate Premium (%)	0	0	0	0	0	0	0	0	0	0
Equilibrium Exchange Rate (Soms/$)	46	46	46	46	46	46	46	46	46	46
C.I.F. (Soms/Unit)	411,700	793,500	6,440,000	105,800	8,280	23,000	50,600	87,400	8.28	24.84
VAT on Border (%)	20	20	20	20	20	20	20	20	20	20
Transportation to Farm Gate (Soms)	4,000	6,000	6,000	4,000	4,000	4,000	4,000	4,000	0	0
Price at Farm Gate (Soms)	498,040	958,200	7,734,000	130,960	13,936	31,600	64,720	108,880	9.9	29.8
Expected Life (years)	15	15	15	15	10	10	10	10	n/a	n/a
Interest Rate (%)	18	18	18	18	18	18	18	18	18	18
Salvage Value ($)	1,000	1,500	1,500	230	18	50	110	190	1,500	1,500
Salvage (Soms)	46,000	69,000	69,000	10,580	828	2,300	5,060	8,740	n/a	n/a
Salvage Net Present Value (Soms)	3,842	5,763	5,763	884	158	439	967	1,670	n/a	n/a
Depreciation (Soms/year)	97,062	187,061	1,517,847	25,547	3,066	6,934	14,186	23,856	n/a	n/a
R&M (Soms/year)	10,293	19,838	161,000	2,645	0	0	0	1,748	n/a	n/a
Machine operation (hours/year)	1,500	1,500	200	800	300	250	250	200	n/a	n/a
Depreciation (Soms/hour)	**71.57**	**137.93**	**8,394.24**	**35.24**	**10.22**	**27.73**	**56.74**	**128.02**	**n/a**	**n/a**

Table B.2. Depreciation Costs of Machinery Per Hour—Social Prices

Details	Social Prices									
	Tractor (MTZ-80)	Tractor (DT-75)	Combine Harvester Mega 204	Spraying Machine	Plow	Harrow	Cultivator	Sowing Machine	Fuel	Grease, Oil
									(L)	
F.O.B. ($/unit)	8,950	17,250	140,000	2,300	180	500	1,100	1,900	0.180	0.540
Freight and Insurance ($/unit)	800	1,200	1,400	345	27	75	165	285	0.020	0.050
C.I.F ($/unit)	9,750	18,450	141,400	2,645	207	575	1,265	2,185	0.200	0.590
Official Exchange Rate (Soms/$)	46	46	46	46	46	46	46	46	46	46
Exchange Rate Premium (%)	0	0	0	0	0	0	0	0	0	0
Equilibrium Exchange Rate (Soms/$)	46	46	46	46	46	46	46	46	46	46
C.I.F. (Soms/unit)	411,700	793,500	6,440,000	105,800	8,280	23,000	50,600	87,400	8.28	24.84
VAT on Border (%)	0	0	0	0	0	0	0	0	0	0
Transportation to Farm-Gate (Soms)	4,000	6,000	6,000	4,000	4,000	4,000	4,000	4,000	0	0
Price at Farm-Gate (Soms)	415,700	799,500	6,446,000	109,800	12,280	27,000	54,600	91,400	8.3	24.8
Expected Life (years)	15	15	15	15	10	10	10	10	n/a	n/a
Interest Rate (%)	9	9	9	9	9	9	9	9	9	9
Salvage Value ($)	1,000	1,500	1,500	230	18	50	110	190	1,500	1,500
Salvage (Soms)	46,000	69,000	69,000	10,580	828	2,300	5,060	8,740	n/a	n/a
Salvage Net Present Value	12,629	18,943	18,943	2,905	350	972	2,137	3,692	n/a	n/a
Depreciation (Soms/year)	50,005	96,835	797,333	13,261	1,859	4,056	8,175	13,667	n/a	n/a
R&M (Soms/year)	10,293	19,838	161,000	2,645	0	0	0	1,748	n/a	n/a
Machine operation (hours/year)	1,500	1,500	200	800	300	250	250	200	n/a	n/a
Depreciation (Soms/hour)	**40.20**	**77.78**	**4,791.67**	**19.88**	**6.20**	**16.22**	**32.70**	**77.07**	**n/a**	**n/a**

Table B.3. Cost Structure of Machinery Services—Private Prices

Details	Agricultural Machine	Hours per ha	Services/ha (Soms, excluding fuel)	Tractor Cost	Labor Cost Small Farms	Labor Cost Large Farms	Fuel Cost/ha	Grease, Oil Cost	Fuel, Grease, Oil Cost	Total Cost/ha
				(Soms)			(L)		(Soms)	
Plowing	MTZ-80	3.0	400	245.37	154.63	30.00	28	2.40	349.75	749.75
Disking	MTZ-80	2.0	250	198.60	51.40	20.00	12	1.60	166.92	416.92
Harrowing	MTZ-80	1.0	200	99.30	100.70	10.00	8	0.80	103.33	303.33
Cultivation	MTZ-80	1.0	250	128.31	121.69	10.00	10	0.80	123.21	373.21
Harrowing rows	MTZ-80	1.0	200	99.30	100.70	10.00	8	0.80	103.33	303.33
Seeding (Sowing)	MTZ-80	1.0	250	199.59	50.41	10.00	8	0.80	103.33	353.33
CPC Spraying	MTZ-80	1.0	300	199.59	100.41	10.00	10	0.80	123.21	423.21
Mowing	MTZ-80	2.0	700	143.14	556.86	20.00	10	1.60	147.05	847.05
Cereal Harvesting (Irrigated)	Mega	0.1	1,650	839.42	810.58	5.00	18	0.08	181.23	1,831.23
Cereal Harvesting (Dry land)	Mega	0.1	1,000	839.42	160.58	5.00	20	0.08	201.10	1,201.10
Straw baling press	Kyrgyzstan	2.0	450	143.14	306.86	20.00	14	1.60	186.80	636.80
Transportation	MTZ-80	1.0	300	71.57	228.43	10.00	5	0.00	49.68	349.68

Table B.4. Cost Structure of Machinery Services—Social Prices

Details	Agricultural Machine	Hours per ha	Services/ha (Soms, excluding fuel)	Tractor Cost	Labor Cost Small Farms	Labor Cost Large Farms	Fuel Cost/ha	Grease, Oil Cost	Fuel, Grease, Oil Cost	Total Cost/ha
				(Soms)			(L)		(Soms)	
Plowing	MTZ-80	3.0	400	139.17	154.63	30.00	28	2.40	291.46	691.46
Disking	MTZ-80	2.0	250	112.84	51.40	20.00	12	1.60	139.10	389.10
Harrowing	MTZ-80	1.0	200	56.42	100.70	10.00	8	0.80	86.11	286.11
Cultivation	MTZ-80	1.0	250	72.90	121.69	10.00	10	0.80	102.67	352.67
Harrowing rows	MTZ-80	1.0	200	56.42	100.70	10.00	8	0.80	86.11	286.11
Seeding (Sowing)	MTZ-80	1.0	200	117.27	50.41	10.00	8	0.80	86.11	286.11
CPC Spraying	MTZ-80	1.0	300	117.27	100.41	10.00	10	0.80	102.67	402.67
Mowing	MTZ-80	2.0	700	80.40	556.86	20.00	10	1.60	122.54	822.54
Cereal Harvesting (Irrigated)	NIVA	0.1	1,650	479.17	810.58	5.00	20	0.08	167.59	1,817.59
Cereal Harvesting (Dry land)	NIVA	0.1	1,000	479.17	160.58	5.00	20	0.08	167.59	1,167.59
Straw baling press	Kyrgyzstan	2.0	750	80.40	306.86	20.00	14	1.60	155.66	905.66
Transportation	MTZ-80	1.0	400	40.20	228.43	10.00	5	0.00	41.40	441.40

Table C.1. Import Parity Prices of Variable Inputs—Private and Social Prices

Details	Private Prices				Social Prices			
	Ammonium Nitrate	Ammonium Phosphate	CPP	Seed	Ammonium Nitrate	Ammonium Phosphate	CPP	Seed
F.O.B. ($/ton)	65	90	4,000	0	65	90	4,000	0
Freight & Insurance	15	15	15	15	15	15	15	15
C.I.F Kyrgyzstan	80	105	4,015	15	80	105	4,015	15
Exchange rate (Soms/$)	46	46	46	46	46	46	46	46
Exchange premium (%)	0	0	0	0	0	0	0	0
Equilibrium exchange rate (Soms/$)	46	46	46	46	46	46	46	46
C.I.F. in domestic currency (Soms/ton)	3,680	4,830	184,690	690	3,680	4,830	184,690	690
VAT on border (%)	20	20	20	20	0	0	0	0
Marketing costs (Soms)	600	600	600	600	600	600	600	600
Transportation to farm gate (Soms/ton)	500	500	500	500	500	500	500	500
Farm-gate import parity value (Soms/ton)	5,378	6,758	222,590	1,790	4,780	5,930	185,790	1,790
Price (Soms/kg)	5.38	6.76	222.59	1.79	4.78	5.93	185.79	1.79

Table D.1. Non-Traded Farm-Gate Parity Prices for Outputs, Osh 1999-2002

Details	Cotton	Wheat	Maize	Rice	Barley	Sunflowers	Potatoes	Onions	Tomatoes	Cucumbers	Water-melons	Tomato (g-house)	Cucumbers (g-house)	Water-melons (g-house)
Local Wholesale Prices														
Average	13.98	4.88	4.46	19.38	3.62	9.34	3.75	2.54	2.36	3.47	3.0374	41.42	40.60	16.07
Minimum	11.37	3.79	3.54	16.49	3.14	7.82	2.63	1.36	1.94	2.61	2.4384	35.60	36.55	14.83
Maximum	16.90	5.88	6.45	22.16	3.91	11.00	4.73	3.18	2.98	4.22	4.2528	46.89	53.15	17.26
Transportation From Farm Gate, (Soms/kg)	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.20	0.40	0.80	0.80	0.80	1.60	0.80
Distribution Costs, Soms/kg	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.23	0.45	0.90	0.90	0.90	1.80	0.90
Parity Value at Farm Gate (Soms/kg)														
Average	13.70	4.59	4.18	19.10	3.33	9.06	3.47	2.12	1.51	1.77	1.34	39.72	37.20	14.37
Minimum	11.09	3.50	3.26	16.21	2.86	7.53	2.35	0.94	1.09	0.91	0.74	33.90	33.15	13.13
Maximum	16.62	5.59	6.17	21.87	3.63	10.72	4.45	2.75	2.13	2.52	2.55	45.19	49.75	15.56

Table D.2. Import Parity Prices for Outputs—Private and Social Prices

Details	Wheat (Kazakh)	Maize (Kazakh)	Rice (Uzb)	Potatoes (Uzb)	Onions (Uzb)	Tomatoes (Uzb)	Cucumbers (Uzb)	Water-melons (Uzb)	Tomatoes (g-house) (Uzb)	Cucumbers (g-house) (Uzb)	Water-melons (g-house) (Uzb)
F.O.B. Prices (Soms/kg)											
Average	3.40	4.57	17.22	4.04	2.62	1.98	4.03	2.09	37.55	37.70	15.32
Minimum	2.73	2.95	13.70	3.58	1.50	1.55	3.59	1.26	16.93	15.34	14.24
Maximum	4.35	5.97	20.10	5.30	5.39	2.60	4.46	2.27	53.50	49.56	16.41
Freight & Insurance/kg	1.18	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
VAT on Border (%)	20	20	20	20	20	20	20	20	20	20	20
Import Parity Value											
Average	5.26	6.28	21.46	5.65	3.94	3.18	5.64	3.31	45.86	46.04	19.18
Minimum	4.60	4.66	17.94	5.19	2.82	2.75	5.20	2.48	25.24	23.68	18.10
Maximum	6.21	7.68	24.34	6.91	6.71	3.80	6.07	3.49	61.81	57.90	20.27
Transportation to Farm Gate (Soms/ton)											
Import Parity Value at Farm Gate (Soms/ton)	0.04	0.13	0.13	0.13	0.20	0.40	0.40	0.40	0.80	0.80	0.80
Distribution Costs (Soms/kg)	0.05	0.15	0.15	0.15	0.23	0.45	0.45	0.45	0.90	0.90	0.90
Private Parity Value at Farm Gate (Soms/kg)											
Average	5.18	6.00	21.18	5.36	3.52	2.33	4.79	2.46	44.16	44.34	17.48
Minimum	4.51	4.38	17.66	4.90	2.40	1.90	4.35	1.63	23.54	21.98	16.40
Maximum	6.13	7.40	24.06	6.62	6.29	2.95	5.22	2.64	60.11	56.20	18.57
Social Parity Value at Farm Gate (Soms/kg)											
Average	4.50	5.09	17.74	4.56	3.00	1.93	3.98	2.04	36.65	36.80	14.42
Minimum	3.83	3.47	14.22	4.10	1.88	1.50	3.54	1.21	16.03	14.44	13.34
Maximum	5.45	6.49	20.62	5.82	5.77	2.55	4.41	2.22	52.60	48.66	15.51

Table D.3. Export Parity Prices for Outputs—Private and Social Prices, Almaty 1999-2002

Details	Cotton (World)	Maize	Rice	Potatoes	Onions	Tomatoes	Water-melons
C.I.F. Almaty, Kazakhstan (Soms/kg)							
Average	52.33	4.95	18.14	5.63	5.80	8.51	4.52
Minimum	46.87	2.97	16.42	4.52	3.53	6.46	3.11
Maximum	59.89	5.97	19.40	8.40	8.31	11.21	6.63
VAT on Border (%)	0.00	16.00	16.00	16.00	16.00	16.00	16.00
Before VAT Almaty, Kazakhstan (Soms/kg)							
Average	52.33	4.27	15.64	4.86	5.00	7.34	3.89
Minimum	46.87	2.56	14.15	3.90	3.04	5.57	2.68
Maximum	59.89	5.15	16.72	7.24	7.16	9.67	5.72
Optimal Railroad Tonnage Capacity (tons)	60.00	60.00	60.00	50.00	50.00	40.00	50.00
Freight & Insurance (Uzb-Rus) ($/ton)	37.67	21.00	21.00	23.70	23.70	27.75	23.70
Freight & Insurance (Taj-Uzb) ($/ton)	10.83	10.83	10.83	12.40	12.40	14.75	12.40
Freight & Insurance (Kyr-Taj) ($/ton)	3.17	3.17	3.17	3.60	3.60	4.25	3.60
Exchange Rate (Soms/$1)	46.00	46.00	46.00	46.00	46.00	46.00	46.00
Total Freight & Insurance (Soms/ton)	2,377.00	1,610.00	1,610.00	1,826.00	1,826.00	2,151.00	1,826.00
Freight & Insurance (Soms/kg)	2.38	1.61	1.61	1.83	1.83	2.15	1.83
Conversion Factors	0.33	1.00	1.00	1.00	1.00	1.00	1.00
F.O.B. Export Parity Value							
Transportation From Farm Gate (Soms/kg)	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Distribution Costs (Soms/kg)	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Private Parity Value at Farm Gate (Soms/kg)							
Average	16.39	2.37	13.75	2.75	2.89	4.90	1.78
Minimum	14.59	0.67	12.26	1.79	0.93	3.13	0.57
Maximum	18.89	3.25	14.83	5.13	5.05	7.23	3.61
Social Parity Value at Farm Gate (Soms/kg)							
Average	16.39	3.06	16.25	3.52	3.69	6.07	2.41
Minimum	14.59	1.08	14.53	2.41	1.42	4.03	1.49
Maximum	18.89	4.08	17.51	6.29	6.20	8.78	4.52

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